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PERCEPTIONS OF SPORT SCIENCE RELEVANCE AND APPLICATION AMONG SOUTH AFRICAN COACHES AND ATHLETES

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ABSTRACT

The purpose of this study was to examine the perceptions of South African coaches and athletes of the relevance and usefulness of sport science on coaching methods and athletes' performances. Twenty-two coaches (6 rugby; 3 cricket; 5 football; 3 hockey; 5 netball) and twenty-six athletes (5 rugby; 6 cricket; 6 football; 6 hockey; 3 netball) completed a questionnaire evaluating their knowledge, understanding, and the perceived usefulness of sport science. Almost 82% of coaches and 88% of athletes found sport science either "useful" or "very useful" in athletic training and performance. Coaches and athletes demonstrated similar views in areas of sport performance. Athletes considered scientific results/process less useful than coaches to their mental preparation or improving skills and processes. The common barriers to integration of sport science with practice were cost, language used in scientific literature and communication between sport scientists and coaches, as well as relevance of research topics. While the usefulness of sport science was acknowledged by both coaches and athletes, future coach development programmes should emphasise access to and correct use of sport science information. Sport science research should address the needs of the local sport and coaching community to ensure successful knowledge transfer.

Keywords: Perceptions; Sport science; Coaches; Athletes; South Africa.

INTRODUCTION

Sport science is continually evolving, and presently encompasses a wide area of research ranging from injury prevention and rehabilitation, to sport nutrition and sport psychology. Consequently, sport scientists may have a valuable impact on sport performance, and often claim that their research makes a significant contribution to current literature, influencing athletic practice and performance (Bishop, 2008). However, there is general consensus that there are barriers to effective transfer of sport science knowledge to coaches and athletes: the cost associated with research, relevance of topics investigated and language used to communicate the scientific findings (Partington & Orlick, 1987; Sands, 1998; Goldsmith, 2000; Bishop, 2008; Reade *et al.*, 2008a; Martindale & Nash, 2013). Furthermore, research addressing these problems is largely focused on developed countries, whereas limited knowledge is available in African countries, and specifically South Africa.

Several authors (Martindale & Nash, 2013; Kilic & Ince, 2015) depict three common barriers to transfer of scientific knowledge to practitioners: integration and access, the practical application and relevance of topics investigated, and the language used in scientific research

and communication between sport scientists, coaches and athletes. Integration and access to sport-related research requires funding, generally only available for the elite level coaches and teams (Reid *et al.*, 2004). As a result, other coaches and athletes may be limited to the information obtained from other coaches, magazine articles or coaching seminars (Martindale & Nash, 2013). In addition, subscription fees required for most scientific journals may only be available for the university coaches, further reducing access to sport-related research. Reade *et al.* (2008b) indicated that even with the available access, coaches prefer other sources of information due to the language used in scientific literature, which they find hard to understand. According to Martindale and Nash (2013), coaches indicated that it is hard to get to the relevant and applicable information within the pages of graphs, tables and statistical information, which discourages even the more interested and motivated coaches.

The overly technical language may stem from the notion that sport research targets primarily other researchers, rather than coaches and athletes (Bishop *et al*., 2006). Currently, while there is agreement among researchers that research findings should be shared among scientists, coaches and athletes, there are conflicting views on whether sport science should be relevant to coaches or researchers (Bishop *et al*., 2006). Studies report that sport scientists fail to conduct more applied research (Bishop, 2008; Martindale & Nash, 2013), and subsequently produce findings that are too difficult to apply in real world situations, as most research is based in the laboratory (Bishop, 2008).

Reade *et al.* (2008a) indicated that researchers do not ask practically relevant questions, or only use a specific population (Williams & Kendall, 2007b; Reade *et al.*, 2008b) lacking relevance to athletes competing at various levels. However, researchers argue that for optimal study design and internal validity, there is a trade-off with practical relevance (Farquhar *et al.*, 2002). As a result, it is suggested that in order to preserve the quality of research, it would be preferable to educate the intended population about the scientific process (Farquhar *et al.*, 2002; Kilic & Ince, 2015) and interpretation of the results, rather than jeopardising the research validity.

While the barriers discussed primarily address coaches, the athletes are also becoming more aware of the scientific influence on sport performance. A study by Mackie and Legg (1999) on elite sailors, demonstrated that similar to coaches, perception of the usefulness of sport science was relative to athletes' sports science knowledge. Improvement in knowledge of sport science, consequently, improved its perceived usefulness and value, as a tool to aid performance. However, there is very little known research on the perceptions of sport science of athletes from popular team sports.

PURPOSE OF STUDY

Considering current and previous research, the aim of this study was to investigate the experiences, opinions and perceptions of the usefulness of sport science of South African coaches and athletes, participating in five dominant varsity sports.

METHODOLOGY

Participants

South African university coaches, and randomly selected first team athletes were asked to participate in the study. A total of 22 coaches and 26 athletes representing five varsity sports (rugby, cricket, soccer, netball and tennis) completed the survey.

Procedures

A questionnaire and a consent form were personally delivered to all coaches and athletes by a research assistant. The participants were asked to review the survey, and were given an opportunity to ask any questions. After one week, the research assistant collected the surveys.

Survey design

A questionnaire consisting of 31 questions was designed to measure coaches' and athletes' knowledge, understanding, experience and the perceived usefulness of sport science. The questionnaire was adopted from the questions in the existing literature related to sport science relevance and practical application, in particular Williams and Kendall (2007a) and Martindale and Nash (2013). The first section, consisting of six open-ended questions, addressed coaches' and athletes' perception of the usefulness of sport science, perceived barriers to research-practical relationships and knowledge of related concepts (VO_{2max} and muscle soreness). The second section consisted of closed-ended questions and addressed those attributes coaches and athletes consider important. Attributes assessed were applicable to research areas, the qualities and characteristics a sport scientist should possess, and the barriers to the application of sport science. This section consisted of 24 questions structured for response by applying a 5-point Likert scale for the purpose of rating and ranged from 1 ("strongly disagree" or "not useful") to 5 ("strongly agree" or "very useful") (see Addendum).

To ensure the content validity of the tests, all items were reviewed by a practising physiologist accredited by the British Association of Sport and Exercise Sciences (BASES). Ethical clearance was granted by the Ethics Committee of Stellenbosch University.

Data analysis

Statistical analysis was completed with SPSS (Version 22.0, IBM Corporation, New York, USA). The means and standard deviations were compared with an unpaired t-test and significance set at α=0.05. The responses to open-ended questions in Section 1 were categorised based on a common theme, or coded to scale as "no knowledge", "some knowledge" and "full knowledge".

RESULTS

A total of 26 athletes (age: 21.7±1.5 years) and 22 coaches (age: 37.2±4.7 years) completed the survey. Their characteristics are depicted in Tables 2 and 3 respectively. While all athletes were university players, some athletes also competed at provincial, regional and national level. All coaches reported having more than 10 years of experience as a coach, and 59.1% held a bachelor's degree or higher (master's degree, n=5; honour's degree, n=1; bachelor's degree, n=7; national diploma, n=3; national certificate, n=6).

***Table 1*. CHARACTERISTICS OF ATHLETES**

Sport	n	Age	Years in sport
Cricket	6	20.7±1.1	14.8±1.6
Football	6	24.0±1.9	13.8±2.9
Hockey	6	20.3±1.1	13.2±2.7
Netball	3	21.0±1.4	14.7±1.9
Rugby	5	22.4±1.0	15.6±1.2
Total	26	21.7±1.5	14.4±0.9

***Table 2*. CHARACTERISTICS OF COACHES**

Sport	n	Age	Years in sport	Years coaching
Cricket	3	36.3±4.5	30.7±6.4	13.0±1.6
Football	5	30.7±11.6	21.0±13.4	10.0±7.1
Hockey	3	35.6±9.6	27.0±8.1	10.8±4.8
Netball	5	41.2±7.2	27.5±8.8	12.5±4.8
Rugby	6	42.2±6.4	31.2±4.7	16.4±12.1
Total	22	37.2±4.7	27.5±4.1	12.5±2.5

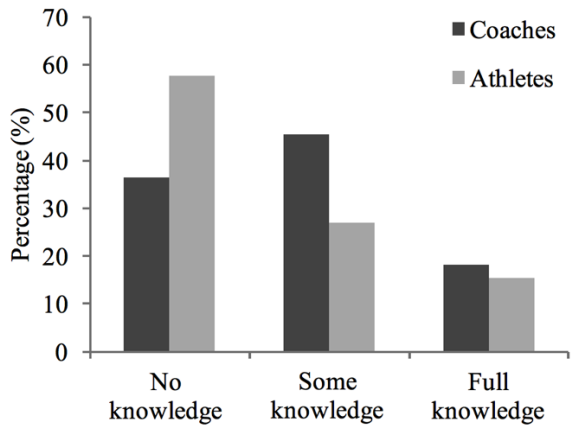

***Figure 1*. PARTICIPANTS: KNOWLEDGE OF A VO_{2MAX} TEST**

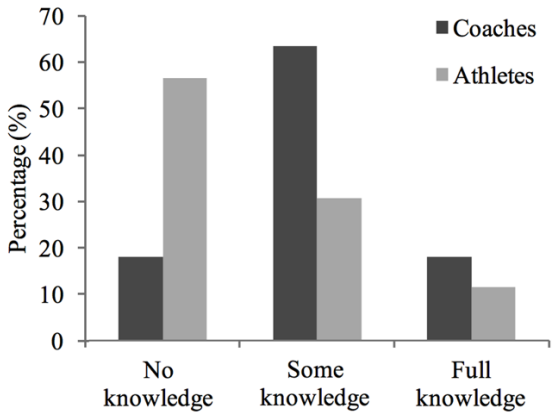

***Figure 2*. PARTICIPANTS: KNOWLEDGE OF MUSCLE SORENESS**

Figures 1 and 2 depict the differences in knowledge of basic sport science concepts between the coaches and athletes. Only 18% of coaches had an understanding of theVO_{2max} test, and the causes of muscle soreness, while the athletes' percentage was even lower, 15% for the VO_{2max} test, and 11% for causes of muscle soreness. Majority of coaches had some idea of what both concepts mean. Athletes on the other hand, were mainly without any understanding of these concepts.

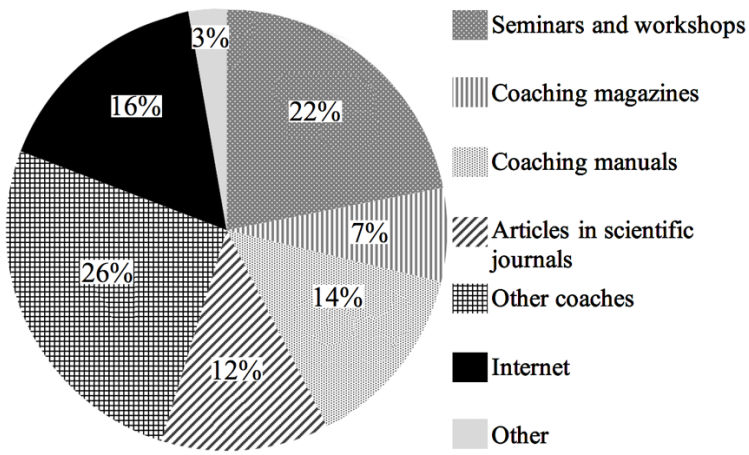

***Figure 3.* SOURCES COACHES USED IN THEIR TRAINING**

Relative to obtaining additional training and making use of continued education, most coaches receive coaching-relevant information from other coaches, seminars and workshops, and only 12% sought relevant information from scientific journals (Figure 3). The percentage of information received through collaborations with other practitioners (48%) (conferences and

coaches) is about the same as gathering information through every-day available resources (magazines, internet) (49%).

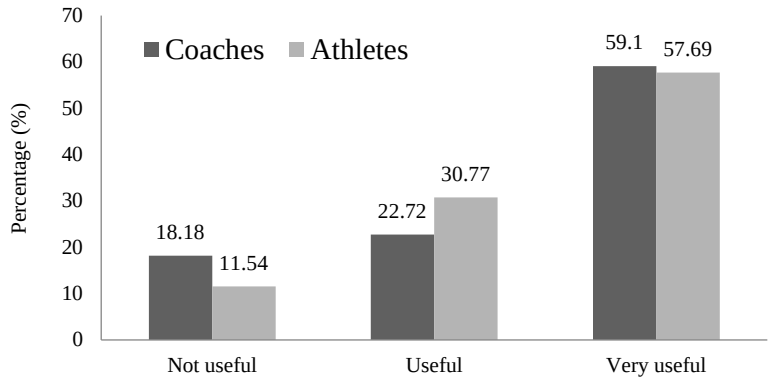

Figure 4. **PERCENTAGE OF PARTICIPANTS FINDING SPORT SCIENCE USEFUL**

According to the responses to the open-ended questions, almost all coaches had a chance to work with a sport scientist. Almost 82% of the interviewed coaches find sport science either "useful" or "very useful" in athletic training and performance (Figure 4). Similarly, the majority of the interviewed athletes had the opportunity to work with a sport scientist, and more than 88% find sport science either "useful" or "very useful" for improving athletic training and performance (Figure 4)

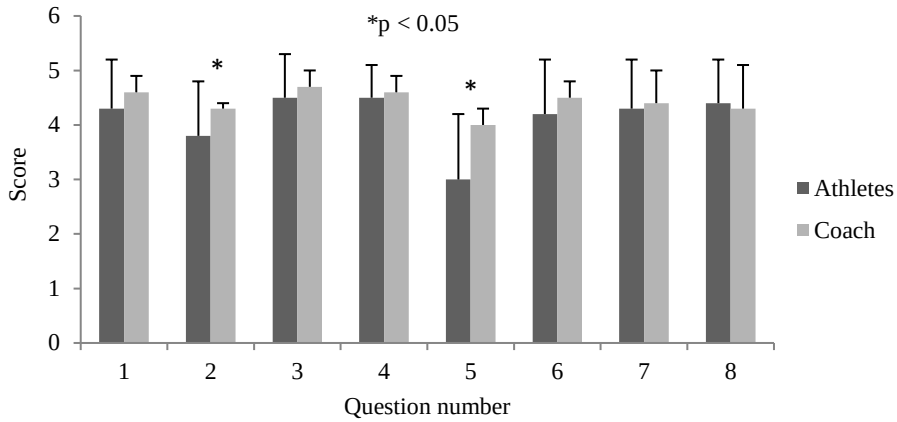

Figure 5. **RATINGS OF PERCEIVED USEFULNESS OF SPORT SCIENCE RELATIVE TO SPORT PERFORMANCE FACTORS**

While athletes and coaches had very similar perceptions that sport science can contribute to various aspects of sport performance, the athletes rated "improving skills and technique" and "mental preparation" significantly lower than coaches ($p<0.05$) (Figure 5).

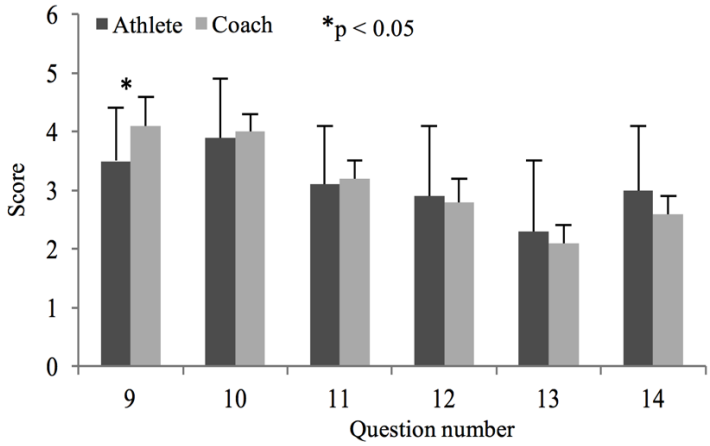

Figure 6. **RATINGS OF RELEVANCE AND USEFULLNES OF SPORT SCIENCE CORRESPONDING TO QUESTIONS**

Furthermore, the athletes more than the coaches ($p<0.05$) believe that coaches should supplement their coaching with more applied research (Figure 6). However, coaches more than athletes ($p<0.05$) agree in being proactive in sport science research within their respective roles (Figure 7).

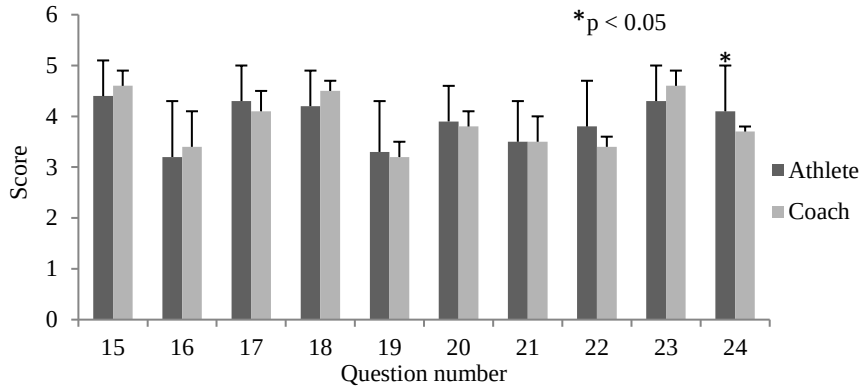

Figure 7. **RATINGS OF CHARACTERISTICS OF A SPORT SCIENTIST AS VALUED BY ATHLETES AND COACHES**

Barriers to implementing sports science in practice differed between coaches and athletes. Coaches identified financial obligations, the notion that sport scientists lack practical

knowledge of the sport, the lack of research targeting the needs of the coach or athlete and communication as the primary barriers. Athletes on the other hand, identify coaches, with their "old-fashioned" strategies and the unwillingness to adapt to the scientific findings, as the primary barrier to practical application of sport science. An additional theme identified by the athletes is the belief that a sport scientist does not have practical knowledge of the sport or the time to produce results, especially relative to injury and recovery.

DISCUSSION AND RECOMMENDATIONS

Coaches and athletes need to continually advance their training strategies in order to maintain the highest level of performance of the athletes, as a result, they maintain competiveness with their rivals. Continuous research in sports science addresses various aspects of sport performance that may aid coaches and athletes achieve this goal. However, previous research identified a significant gap between sport science and its practical application by coaches and athletes. Currently there are no known studies identify this relationship in South African sports. Therefore, the aim of this study was to investigate the perceptions of South African coaches and athletes on the usefulness and value of sport science in athletic performance, and the barriers to its application, across five different sports. The primary findings show that coaches and athletes agree that sport science (research) is needed for further sport development, and can significantly contribute to coaching and athletic performance. However, implementation of sport science into practice is hindered by cost, role and communication between a sport scientist and a coach, and the practical relevance of research. These factors are discussed below; quotes are used to identify the answer categorisation, and key messages emerging from responses.

Perception and knowledge of sport science

In this study, both athletes and coaches had a very broad definition of sport science, with very "generic" answers commonly themed around "performance improvement" of the athlete, using "scientific approach" and "different training modalities". For example, sport science is considered "a tool to develop a sports person to reach maximum potential through better training, nutrition and mental aspects of the game", and the main objective of sport science is "to improve performance… through correct exercise programmes and monitoring".

Athletes had similar generic perceptions of sports sciences stating that it is "the study of sport covering different aspects (performance, nutrition, etc.) and aimed at improving athletes in a specific sport". Some athletes correctly incorporated various aspects of sport performance within the scope of sport science and included "… performance, coaching, sports injuries, nutrition, periodisation, analysis, and how this can be implemented to improve sporting performance". Interestingly, only a few athletes included the research aspect of sport performance indicating that sport science uses "research and investigates all the areas of sport to further our knowledge of sport and the science behind it", and that it utilises "researching methods and activities that enhance performance".

Considering that most coaches and athletes had at least some experience working with a sport scientist, these responses are most likely the result of general experience and interactions within a university environment, where contact with sport scientists is common. As a result, both coaches and athletes had experiences that were deemed positive. Similarly, their responses to

the usefulness of sport science were also positive (Figure 4), but the questionnaire answers were very generic, and might have resulted from generally positive experiences while working with a sport scientist. For example, the coaches stated that through their experience the job of a sport scientist is "very useful and is important in the modern game" and that it is important to use "their [sport scientists] individual strengths to achieve good results", and acknowledged that "the knowledge gained from a sport scientist can help to be successful at club and provincial level".

The generalisation of perceptions of sport science in this study resembles that reported previously (Bishop *et al*., 2006) and might be associated with the perception of usefulness. Those who perceived sport sciences as useful and having an important role, tend to define sport science more broadly (Martindale & Nash, 2013). In general, the quotes throughout this section demonstrate that coaches and athletes possess adequate understanding of basic principles of sport science and its application, irrespective of their sport. Despite the general agreement, coaches and athletes find sport science useful in some areas of sport performance more than others.

Areas of research relevance

Both coaches and athletes find that the highest valued contributions of sport science are related to helping athletes reach their peak for competition (question 1), reduce injury (question 3), and develop recovery strategies (question 4) (Figure 5). Interestingly, these attributes may be considered performance characteristics relating to the entire team, rather than the performance of an individual athlete. Relative to the more individual performance characteristics, such as skills, technique and mental preparation, coaches rate scientific input significantly higher than athletes (Figure 5). It is likely that athletes may not value (constructive) criticism of their skills and technique from a sport scientist who has not had coaching experience (question 13), actively participated in the sport (question 14) or has knowledge of the sport (questions 15) (Figures 6 and 7). This has been demonstrated previously in a study by Lovel *et al.* (2013), who found that sport scientists were perceived ineffective if they were considered to lack practical experience in applying their knowledge to a specific sport. Furthermore, it has been demonstrated before (Pain & Harwood, 2004) that athletes have a negative perception of psychology, which may explain the low value for the significance of mental preparation.

However, the coaches also value the input of a sport scientist in mental preparation and improvement in skills and technique, significantly higher than athletes, and find coaching and playing experience a preferred attribute of the sport scientists (Figure 6). It is likely that coaches prefer to focus on team performance rather than the skills of individual athletes, especially at the competitive university level, where athletes may be expected to have achieved a certain skill level (Martindale & Nash, 2013). Furthermore, in sports with a large number of players, such as rugby, coaches may not find it practical or time efficient to coach each player individually, but rather want a player with developed skills that can be immediately applied. Relative to psychology in sport, coaches may not possess sufficient knowledge to assess the significance and relevance of mental preparation before, during and after the game (Pain & Harwood, 2004). This becomes crucial especially during periods of high stress for student athletes, such as examinations or games of high importance. In these, and similar situations, knowing various coping strategies and learning how to perform under high stress, may not be

obtainable from coaches, whereas a sport scientist specialising in sport psychology could provide significant input (Pain & Harwood, 2004). This potential lack of interest in sport psychology as a branch of sport science, highlights only one of several barriers of efficient implementation of sport science or a scientist by coaches or athletes.

Barriers to efficient implementation of sport science within practice

While over 80% of coaches and athletes find sport science useful and recognise its benefits in all spheres of sport performance, more pro-active use of sport scientists is hindered by several barriers identified in this study. Similar to previous research, the main barriers are cost, roles and communication, and relevance of research (Pain & Harwood, 2004; Martindale & Nash, 2013). From the perspective of the coaches, it is not financially viable to use the services of sport scientists, especially if the teams would like to implement specialists in several different areas. For example, when asked about barriers to implementation of sport science, one coach listed simply, "the financial costs of services from biokineticists, physiotherapists, sport psychologists, fitness instructors (or dieticians)".

While cost may not represent the problem in a more professional setting with large financial support, universities, high schools or local clubs may not have sufficient funds to support the additional costs associated with hiring professionals. From observation, although rugby may be the most funded university sport in South Africa, sports that are not as popular as rugby, may not receive the same amount of funding. However, this was not investigated in the present study, and may be a relevant topic for future research.

While the practical application of the sport scientists may be financially impractical for university coaches, scientific literature is readily available on-line or via university subscriptions to scientific journals. Still, despite the availability, only 12% of the information the coaches used comes from scientific journals, whereas 88% comes from other coaches, seminars and workshops, which is consistent with previous research (Figure 3) (Reade *et al.*, 2008b; Kilic & Ince, 2015). Although the information obtained from the workshops, seminars and other coaches may come from scientific sources, there seems to be a barrier using more literature from scientific journals or even the sport scientists according to the coaches. Interestingly, sport scientists were not mentioned as a source of relevant information to be used in coaching. It is not clear at this time whether coaches have the time, required for a search through scientific literature, or access to the scientific databases, it may be more effective and practically accessible to incorporate relevant research findings through coaching forums, coaching accreditation material, and include applied research of sport scientists in coaching conferences (Sands, 1998). While the importance of available resources and access to sport scientists is clear, the use of appropriate language to convey information effectively to coaches seems to be more critical.

Language and communication

In this study, and as previously reported, language used in scientific literature, and in communication between coaches and sport scientists, is one of the major barriers to seeking information from these sources (Pain & Harwood, 2004; Reade *et al*., 2008a; Martindale & Nash, 2013). The results of the survey indicate that the use of scientific language in scientific journals, and in communication with sports scientists is a major obstacle to better understand

the relevance of scientific results and the consequent practical implementation, which has been demonstrated before (Sands, 1998; Martindale & Nash, 2013). In this study, this was elaborated in the following responses: "sports scientists need to communicate in a language that the coaches understand" and "… the language. Sport scientists need to communicate in a language that the coaches understand".

While it is relatively optimistic to expect coaches to pursue scientific literature on their own, collaboration with a sport scientist might bridge the gap and serve as incentive to an applied sport focus of scientific literature (Martindale & Nash, 2013). While coaches also indicate that sport scientists tend to speak in ways that the coaches do not understand and the information given does not always apply to their sport, athletes have different perceptions of communication between a coach and a player. Athletes indicated that coaches are either "unwilling to embrace new ideas" or "too old school or unaware of the positive impact a sport scientist can have". In either case, there is a lack of efficient communication between the scientist and coach, resulting in coaches being reluctant to accept the ideas they do not understand. Therefore, there is a need for sport scientists to emphasise and make the relevance of the research clear and to focus their work on a sport-specific coaching context (Williams & Kendall, 2007a; Kilic & Ince, 2015).

Although the lack of applied relevance of sport science demonstrated in this study concerning South African coaches and athletes, this problem has been documented a few decades ago on a global scale (Sands, 1998; Goldsmith, 2000). However, improving the communication between sport scientists and coaches and athletes should be considered a short term solution (Palm & Harwood, 2004). A long term solution should involve educating coaches to distinguish what is relevant and applicable within any given context and to provide the tools to utilise the scientific information efficiently (Martindale & Nash, 2013; Kilic & Ince, 2015). Bishop (2008) states that formal education programmes for coaches have little impact on coach development, which would affect their ability to assess relevant scientific information. Continuing education is present in all spheres of professional practices, and with numerous sports organisations providing specialised courses, implementation of such courses for coaches should be investigated further.

Role of the sport scientist

Lastly, in Figure 7, the coaches and athletes indicated that a practitioner has to have significant knowledge of the respective sport (question 15). This was another common and widely indicated barrier that reflects on the perceived ability of sport scientists to apply the knowledge effectively. These findings have also been demonstrated before (Partington & Orlick, 1987), however, it is evident that the problem still persists. The problem may lie in the perception that a sport scientist may undermine the qualities of the coach, eventually minimising the role and the impact of coaches on the team. Some coaches stated that it is important to understand that "the sport scientist is not there to replace or undermine him (coach), but to assist him in all facets of performance and in return, the sport scientist has to accept his role in the team as one of support to both the players and the coach". The most common response was that the sport scientists "should assist coaches with the improvement of players and teams, but they must not replace them".

The perception of the athletes was within the same context of roles, yet expressed in a way that challenges the knowledge and authority of coaches. For example, some athletes indicated that "in many cases the pride of the coaches is too high" and "the unwillingness of coaches to use external help or modern technology and knowledge".

Given that primary concern is the role of a sport scientist within the team, it may be useful to consult an external authority that would best facilitate the process of the integration of the sport scientist within a team (Martindale & Nash, 2013). This action would be relative to the previous questions of financial ability to support the work of a sport scientist. Considering that this study was conducted on primarily university coaches and players, academic institutions may take a leading role in facilitating better interaction and integration of sport science and scientists within a team. As mentioned earlier, this may be the primary reason why some coaches had significant experience with student interns.

CONCLUSION

Although coaches and athletes agree that sport science can significantly contribute to better athletic performance, there are significant barriers to practical implementation of scientific outcomes to improve athletic performance. In South Africa, these barriers are not different from those previously reported in other countries. Hence, there needs to be a fundamental change, in the way many sport scientists think about the research process and also give recognition to coaches, by considering a more pro-active approach in integrating outcomes of sport science into their coaching and practice. Institutions of higher learning should initiate new models of applied research, where sport science research addresses the needs of the local coaches and provides evidence-based research on improving athletic performance. In addition, coaches should take a more pro-active role in using the tools already available, such as user-friendly web-based tools that simplify relevant research in sport science. Further steps should be taken to raise the awareness of coaches and athletes of such tools and the potential research to address their effectiveness.

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SEE ADDENDUM THAT FOLLOWS

ADDENDUM

QUESTIONS/STATEMENTS TO RATE PERCEPTIONS OF
COACHES AND ATHLETES ABOUT USEFULNESS OF SPORTS SCIENCE

On a scale of 1 to 5, rate where you think services of a sport scientist can be most useful.
1=Not useful to 5=Very useful.

1. Helping athletes peak for competition	
2. Improve skills and techniques	
3. Reducing incidence of injury illness	
4. Development of recovery techniques and schedules for athletes	
5. Mental preparation	
6. Speed of recovery from injury	
7. Develop strength/power	
8. Enhance aerobic stamina	

On a scale of 1 to 5, rate the following statements.
1=Strongly disagree to 5=Strongly agree

9. More research should be based in real world setting	
10. Sport science/medicine research influences what elite coaches do	
11. Technical aspects of coaching need to be based on sport science/medicine research	
12. Performance based research is only of value if elite athletes are used	
13. Sport science researchers do not need to have coaching experience	
14. Sport science researchers must have participated in sport at high level	

On a scale of 1 to 5, rate the qualities you would prefer in a sport scientist.
1=Not relevant to 5=Highly relevant

15. Knowledge in involved sport	
16. Must have participated in the involved sport	
17. Experience working with coaches and athletes	
18. Good rapport with coaches and athletes	
19. Presenting at conferences/seminars/workshops	
20. Professional qualifications/affiliations	
21. Must have coaching experience	
22. Must have post-graduate degree in sport science	
23. Excellent communication skills	
24. Actively involved in sport science research.	