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The implementation of performance analysis and feedback within Olympic sport: The performance analyst's perspective

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Abstract

The study considered performance analysis and feedback from the perspective of the performance analyst through the investigation of the 'what', 'how' and 'when' of practice within a selection of Olympic sports. Twenty-three performance analysts (experience 6.4 ± 4.1 years) engaged in a structured interview (85 ± 15 min) regarding their processes within applied practice. Likert scales (All the time, Often, Sometimes, Rarely and Never) were used to facilitate cross-sport and environment comparison. The performance analysts highlighted the experience of their coaches as the most prominent feature influencing analysis direction, and time had the greatest impact upon feedback provision. The main analysis techniques used were video, profiling and performance reports. Feedback was delivered primarily either, (1) < 1-h post-performance within sessions lasting < 10-min or (2) the following day within sessions lasting 25 + min. Video feedback was usually coach led; however, data delivery was more evenly distributed between coach and analyst. Very similar processes across the participants were identified, despite a wide variety of sports and participant experience levels. The findings have begun to illustrate practice within elite sport whilst highlighting the importance and need for further practitioner-based investigation regarding the use of performance analysis and feedback within applied contexts.

Keywords

Coaching process, sport technology, video

Introduction

Performance analysis is an integral tool within the coaching process by virtue of the desire to provide effective and accurate feedback.[1–3] The timing and frequency of feedback have been widely investigated within motor learning research (for a review, see Wulf and Shea[4]). However, investigations involve predominantly lab-based methods, simple skill performance (e.g. throwing) or restriction of sensory information (e.g. sight). These bear little resemblance to the 'real world' of sports performance that involve complex and multiple degrees of freedom skills that require extensive practice to master.[5]

Sports feedback has traditionally involved subjective observations based on a coach's perceptions and experiences.[6] Human observation has been studied in relation to memory recall[7] and criminal identification[8] with little attention to sport except for an assessment of a coach's observational role, i.e. recall, assessment and appraisal.[9–11] Franks and Miller[9] identified observational accuracy (mean recall – 42%) of novice soccer coaches (third year Physical Education students) to be more effective for certain variables (e.g. shooting) than others (e.g. passing), assessed after viewing an international soccer match. Subsequent research[10–12] incorporating (1) memory training, (2) greater task

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specificity and (3) greater domain experience, further illustrated limitations within an observer's ability to successfully recollect (<58% recall). However, these studies failed to acknowledge that domain expertise might allow some events to be forgotten, as they were not important for the formulation of effective feedback. Potentially, coaches refine their observational skills, over time through experience, to only focus upon those aspects deemed important or ignore unimportant information. Irrespective of this, the potential for error in a coach's view of a game has been used to substantiate the need for performance analysis to support coaching observations. For example, Butterworth et al.[13] suggested the efficient and effective use of performance analysis to better interpret the complex nature of performance and provide appropriate, comprehensive and objective feedback is fundamental to learning and development.

Performance analysis research has mainly considered key performance indicators,[14] data collection systems and reliability,[15] profiling and prediction[16] and work rate analysis.[17] Groom et al.[18] suggested that while academics consider the 'what' of performance analysis, regarding issues such as system design and reliability, the 'how' or use of this information remains unclear and largely overlooked. A divide between the needs and goals of the academic researcher and the applied practitioner has therefore been identified, although the extent to which this is either an issue or a problem has yet to be determined.

The widespread use of video-based performance analysis demonstrates a perceived practical efficacy;[18] however, limited research exists regarding its effectiveness,[19–22] meaning its impact is unknown.[23] Studies attempting to discern the effectiveness of performance analysis feedback were confounded, e.g. opposition quality varied between matches, making it difficult to attribute performance changes to performance analysis support.[20] Furthermore, intervention studies tend not to have control groups making experimental effects difficult to distinguish from random effects. However, prior to assessing the effectiveness of feedback, the identification of the 'what', 'when', 'how' and 'why' of performance analysis interventions in the applied environment needs to be established.

Applied performance analysis has been studied[18,24–28] primarily in football and rugby union to understand (1) 'what' took place within sessions and (2) 'how' performance analysis and the analyst was utilised. Groom and Cushion[24] concluded that video-aided recall, developed understanding, encouraged self-critique, provided the chance to reflect without emotions and improved player confidence (Francis and Jones[25] made similar inferences). Groom et al.[18] developed a feedback delivery framework through grounded theory consisting of three concepts (contextual factors, delivery approach and targeted outcome), with each having sub-concepts to consider within future session development. For example, to change behaviour (targeted outcome), the contextual factors (e.g. session design) and delivery approach (e.g. motivational videos) are modified to elicit the desired change. Whilst this has been developed from an applied context, it has not yet been assessed for its impact within the applied environment.

Wright et al.[26–28] assessed the role, value and engagement of the coach, analyst and athlete within the feedback cycle. The majority of coaches were provided with video after most games[26] with coaches stating their philosophy and time impacted upon both analysis and feedback provision (see also Groom et al.[18] and Mooney et al.[29]). Analysis took 2–3 h to complete and feedback was delivered within sessions lasting 0–20 min.[27] In addition, only 12.5% of analysts primarily delivered feedback sessions; however, over 60% stated that they had some form of input within the session. These studies have begun to demonstrate the importance of the analyst's role within the whole feedback process (from capture to feedback) regarding input and, in some instances, session delivery. Wright et al.[28] investigated player views towards timing, frequency and duration of sessions, with the majority of players preferring feedback delayed by two or more days (58%) within 11–30-min (89%) sessions.

Whilst limited research has provided a useful insight into how performance analysis is utilised in the applied setting, it remains a scarcely explored area particularly in sports other than football and rugby union. Further use of more naturalistic, qualitative or mixed methodological approaches to develop a better understanding of the use of performance analysis[3,23] is warranted. Therefore, the aim of this study was to consider performance analysis and feedback from the perspective of the performance analyst through the investigation of the 'what', 'how' and 'when' of practice within a selection of Olympic sports.

Methods

Participants

Twenty-three performance analysts (experience: 6.4 ± 4.1 years) working in high-performance sport participated in the study. Forty per cent of participants had >8 years' experience, 30% had 4–8 years, and 30% had < 4 years' experience, respectively. All participants had a Sports Science related (74%) or Coaching and/or Sports Development (26%) undergraduate degree, with all but two being in the process of obtaining or having a Master of Science postgraduate degree

(50% – performance analysis; 15% – biomechanics). Furthermore, three had or were in the process of completing a Doctor of Philosophy (2 – biomechanics; 1 – performance analysis). Ethical approval for the study was gained from Middlesex University's ethics committee.

Interview question design

Questions were themed around current research[27] related to the use of performance analysis, feedback and the role of the analyst, as well as discussions/focus groups with applied performance analyst practitioners in order to ensure the study's applied impact. The lead researcher formulated an extensive list of questions, which was condensed/reworded to avoid similar questions being forwarded to review. Five experienced practitioners/academics provided critical reflection upon question appropriateness, wording, clarity and response categories in relation to the overall study aims.[30] The final design incorporated 40 questions (mixture of open and closed) including the themes: (1) competition/training video and data, (2) analysis process and (3) feedback process. Likert scales (i.e. All the time, Often, Sometimes, Rarely and Never) were used for answers to closed questions to facilitate cross-sport comparison. Open questions were included to enable expanded responses and allow individual reflections on experiences.

Procedure

The interview was completed in a one-to-one format (participant and interviewer) lasting 85 ± 15 min and recorded via Dictaphone in a similar manner to Wright et al.[28] and Francis and Jones.[25] Interviews were transcribed within Express Scribe (NCH Swift Sound) and then offered back to each participant to verify response accuracy and provide additional information where appropriate. Closed responses were imported into Excel and collated as frequency counts in relation to the response category and Likert scale. The written transcriptions were imported into the qualitative analysis software, QSR Nvivo 11 (Qualitative Solution Research 2002) for exploration.

Data analysis

Responses were grouped by question and investigated for similarities and differences in relation to participant experience and sports environment. Spoken responses were cross compared with the respective quantitative results to draw out the 'why' of practice. In conjunction with an experienced qualitative researcher, participant quotations were condensed into the most prominent ones deemed to best illustrate the trends in quantitative response. Finally, a findings summary was presented to a selection of analysts involved to verify accuracy and provide feedback upon data interpretation, including quotation selection. Statistical analysis was carried out using SPSS (V21). All questionnaire sub-sections demonstrated *good* to *high* reliabilities (Cronbach's α between .72 and .82). Kruskal–Wallis tests were used to test for differences between the three levels of analyst experience. A significance level of .05 was used for all analyses.

Results and discussion

Factors influencing performance analysis and feedback provision

Over 90% of analysts indicated their coaches' experience/philosophy impacted upon analysis direction (>60% within Mooney et al.[29]), suggesting the ability to articulate their philosophy into variables and behaviours, which could be analysed as an important aspect within the analysis process. The time of season and athlete interaction also played a considerable role, highlighting a number of influencing factors outside of the coach–analyst dynamic (Figure 1). Of the analysts, 43.4% indicated coach with analyst input was the primary influence upon aspects to analyse (Wright et al.[27] – 72.9%). Consequently, an effective coach–analyst relationship whereby both can contribute their views and knowledge within an open environment to best guide performance analysis provision appears important.

In line with Wright et al.[26] and Mooney et al.,[29] time was the main factor impacting the ability to feedback, followed by concerns over feedback quantity and content, e.g. what to deliver (Figure 2). However, to negate the impact of time could be difficult due competition constraints or analysis processes. Specifically, processes could be simplified to enable quicker completion but would likely compromise information depth, potentially affecting usefulness and impact to the coach. Furthermore, recipients could view information in their own time; however, a clear limitation exists regarding whether recipient attention has been successfully directed towards the key messages. Such an approach may likely require follow-up questioning to establish whether the feedback had successfully delivered its message.

Type and elements of performance analysis undertaken

Approximately twice as many analysts consistently provided competition support (62%; pre- or post-

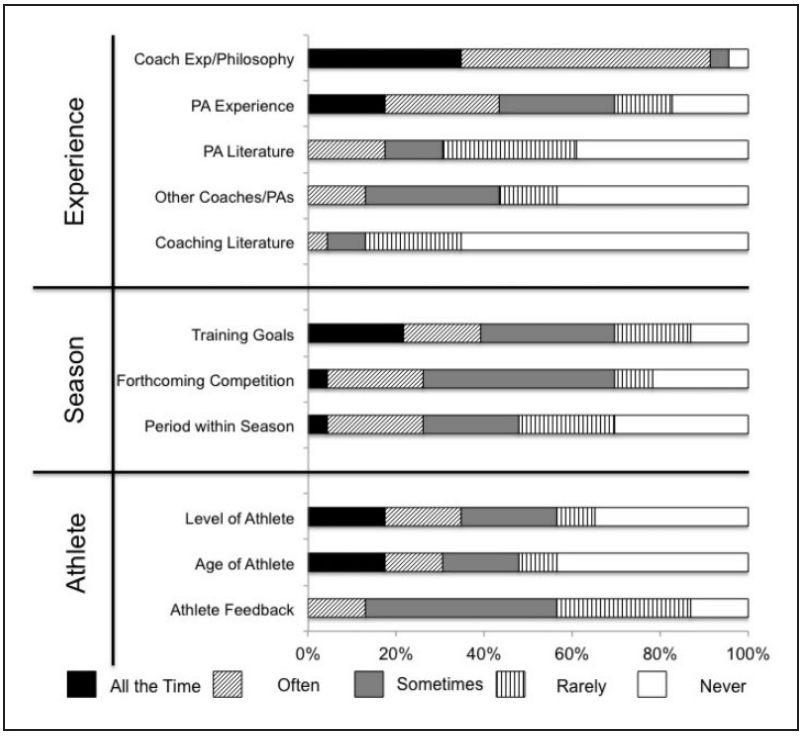

Figure 1. Factors influencing analysis direction.

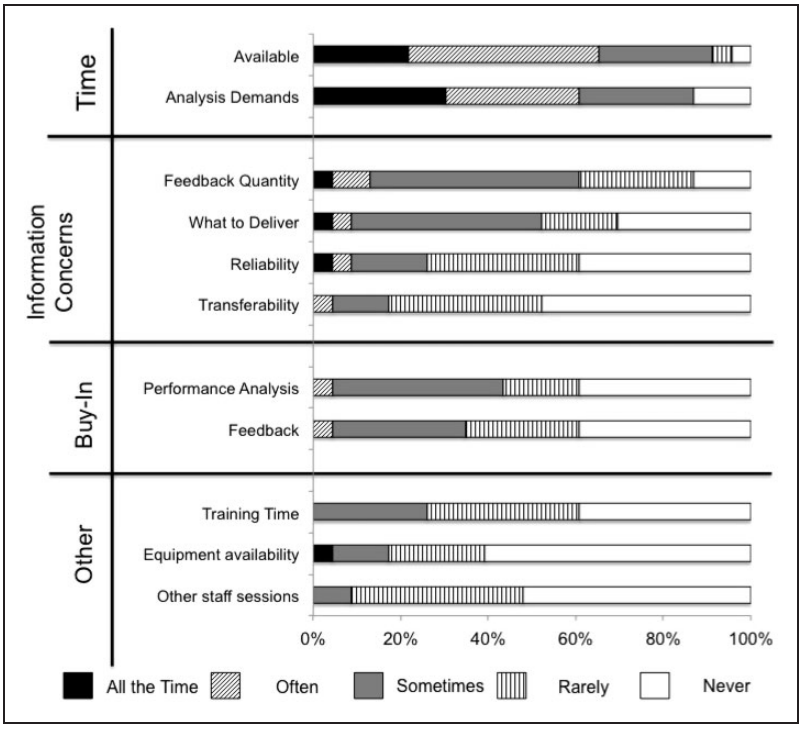

Figure 2. Factors affecting feedback provision.

competition) compared to training (35%), inferring a greater competition focus. The main areas utilised regularly included: (1) full unedited footage, (2) profiling and (3) review documents. Trend and data analysis and strengths and weakness video/reports were the least used aspects (Figure 3).

The assessment of performance and funding sports receive is often largely affected by competition performance (e.g. Olympic Games). For example, UK Sport state 'success is measured by the medals won, the number of medallists developed. . .'.[31] The prioritisation of competition support over training is likely an attempt to facilitate effective performances at these events, and thus meet/exceed their targets. The analysts indicated they utilised video, in full/edited form, on a regular basis within current practice, inferring a significant level of recipient *buy-in*. This observation is in line with previous research[26] that identified the 'vast majority of elite coaches surveyed receive a video, DVD or edited clips'. A number of participants reported how video formed the foundation of performance analysis provision, for example: 'Full video of performance, it doesn't matter what the event is, they'll always get. . .that's kind of the basic, the bones of it' (Participant 23: 0–4 years' experience).

Feedback frequency

The importance of information to enhance performance has been discussed considerably; however, the frequency and timescale of feedback delivery within an applied setting have received limited attention. Similar to Mooney et al.,[29] about three-quarters of participants provided video/data post-performance frequently, with > 86% suggesting that increasing this would be beneficial to learning, although this mainly affirms their belief in their role. Francis and Jones[25] and Wright et al.[28] also suggested the use of video and data supports individual reflection and enables a deeper understanding of performance through a more holistic view. Moreover, increasing feedback, either directly (coach input) or indirectly (individual reflection), may create greater opportunity to impact development. A specific example outlined why increasing feedback was preferable: 'More feedback is the gold standard really, because of the amount of learning that they can immediately do. . .it's something that everybody is

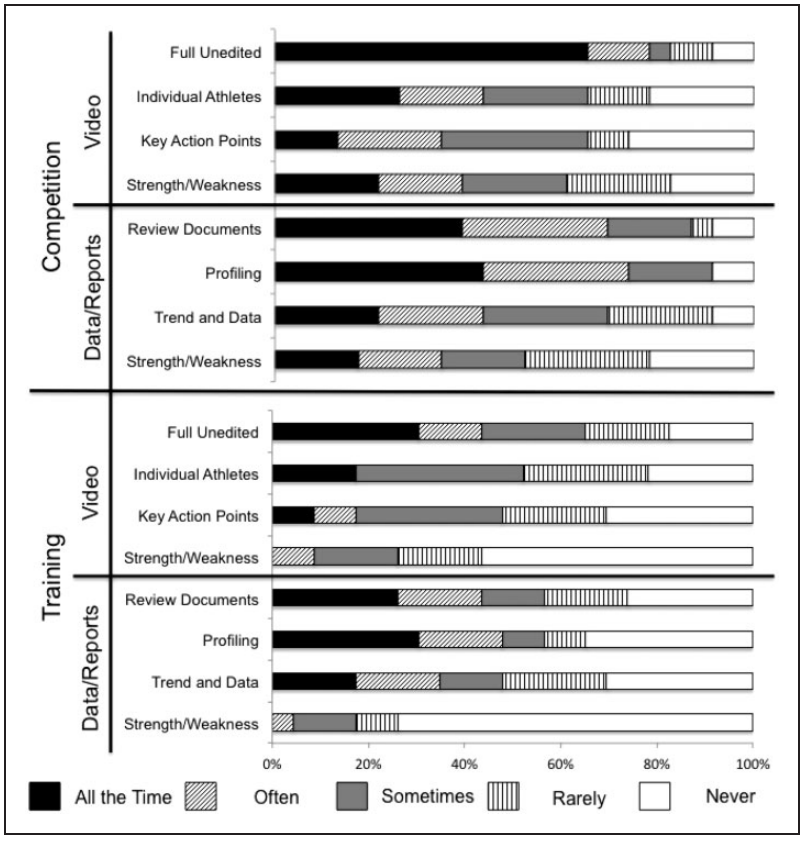

Figure 3. Type of performance analysis provided.

pushing very hard for' (Participant 1: 0–4 years' experience).

Analysts made use of during-performance support within competition far less frequently than desired. A few reasons became evident why this was the case; firstly, many competitions restrict the provision of information during performance. Secondly, the level of information consumed during performance could be considered limited due to the (1) speed of performance and (2) time required to collect/feedback. Two pertinent examples highlighted a desired (1) increase and, in contrast, (2) decrease in during-performance feedback.

> They would watch it [the performance] straight away to then be able to rectify it there, rather than waiting till afterwards to watch it. I just think in terms of their learning process they'd be able to implement that change, or see whether that was effective or not straight away, rather than trying to remember. (Participant 11: 4–8 years' experience)

> The type of sport that [*sport*] is, it's quite a feel and it's quite a style-based sport. Sometimes [*sport*] can be too focused on a specific number, rather than the overall performance, sometimes they'll overthink one particular skill, which throws off the routine. (Participant 15: 8 + years' experience)

Although the majority of participants preferred an increase in feedback, it would appear that a standard approach to feedback frequency might not be effective for all,[28] particularly those conducive to 'overthink one particular skill'. Therefore, learning preferences, personality types and the type of information being presented should be thoroughly considered when deciding upon feedback frequency. Furthermore, the type of performance under review may also influence desired feedback frequency. For example, during the Olympics, hockey nations play eight games in 14 days (if reaching the final), whereas at club level, matches are far less frequent; thus, the desire to receive competition feedback will likely increase during the Olympics compared to a usual competitive schedule.

Feedback timing

Feedback delivery within competition was split between within 1 h and >1 day post-performance; however, there was a consistent theme of Sometimes across response categories within training, indicating no favoured approach. More accurately, the point at which feedback occurs within training will likely depend upon various influencing factors, e.g. what is being practised. A greater number of analysts (14.7%) desired to deliver feedback within 1-h moving forward. These results contrasted with Wright et al.[27,28] and Francis and Jones,[25] where feedback was primarily delivered >2 days post-performance. A more immediate approach to feedback arguably (1) allows the performance to stay fresh in the mind, facilitating performance reflections of greater honesty[32] and (2) allows the recipients to review and focus upon how to rectify errors more immediately.[28] A number of examples were provided to demonstrate why more immediate feedback was preferable:

> To make sure that it's fresh, that it's kept up to date and, that if a coach came to you, for example, if there was no session in the afternoon and the coach came to you with some more detailed questions, you have the ability to talk them through one-to-one. (Participant 1: 0–4 years' experience)

However, some participants, either through sport involvement or experience, voiced their opinions regarding the importance of delaying feedback. McArdle et al.[32] and Groom et al.[18] highlighted the psychologically useful effect and importance of providing *reflection time* to promote objectivity, effective self-reflection and clarity within feedback sessions through the removal of emotions. Early research (see Maslovat and Franks[6] for an introduction to feedback literature) regarding immediate feedback highlighted the potential for athletes to fail to actively engage within the self-reflection process, if the *answers* are consistently provided.

> We'd like to have everything ready within the hour but not necessarily immediately, like give people time to take away the emotion before they view video and data. (Participant 12: 8 + years' experience)

> Within 10 minutes...is too quick, because they haven't actually had time to debrief themselves and actually think it through in their heads, before they actually watch it. I think that it's important that they have time to debrief it in their own heads, and even to... some extent a coach having a chat with them first and saying, right, so how did you feel about that. (Participant 9: 4–8 years' experience)

Wright et al.[28] outlined the use of technology to facilitate the individualistic delivery required by certain recipients. Sharing technology could distribute information quickly, whilst allowing recipients to delay their own access if required, to more effectively remove the emotion and promote objectivity pre-feedback.[32] Furthermore, McArdle et al.[32] highlighted that feedback was an ongoing process, whereby it could be positive to engage in a combination of both approaches (i.e. delayed and immediate).

Feedback session length

No clear approach was apparent regarding feedback session length. However, these findings are arguably not surprising given the wide variety of factors to consider within feedback design, such as situation (competition/training), content (technical/tactical) and athlete (age/level), among various others. Furthermore, Groom et al.[18] outlined context, delivery approach and purpose/targeted outcome as important factors for consideration within the overall design of feedback sessions. In contrast, Wright et al.[27] identified the majority of analysts reported 0–20 min (53%) and 21–40 min (28%) respectively. However, these findings differed from Groom and Cushion[33] where 30–40 min sessions were felt to be 'about right' and 70% stated that they were actually too short.

A preference for a future shift to <20-min feedback sessions was indicated. A benefit of shortening sessions is the need for athletes to remain focused for a shorter period, potentially positively affecting engagement. However, shorter sessions require a clear, more concise and thought about approach that is compiled of extremely key performance information. As a result, more time would be required pre-feedback to effectively select appropriate information. A specific example was provided to outline why a shortened session would be beneficial:

> It's quite important to keep feedback relatively concise because it's very easy to spend hours going through something actually you haven't really hit on the key points. The hours need to happen before the feedback happens, so you go in with a very clear message, these are the outcomes of that session or that competition, these are the key feedback parameters, these are the key performance parameters...you need to keep people engaged with the process as well and I think sometimes people will switch off after 15–20 minutes. (Participant 1: 0–4 years' experience)

Feedback delivery approach

Analysts delivered feedback within a consistent manner (78%) and within an individual setting (>60%), with a clear desire to increase this moving forward. Face-to-face was the primary method of delivery with the use of video/phone very rarely utilised. Video feedback sessions were primarily coach led (similar to Wright et al.[27]), whereas data delivery was more evenly distributed between each group. However, over half of participants desired to feedback via a coach/analyst combined approach. Over one-third of analysts reviewed their feedback methods on an annual basis, whereas 30% tried to maintain the same or similar feedback methods throughout one Olympic cycle (four-year period).

Technology and literature

The development of computer technology has enabled a wide variety of computer-based tools (e.g. SportsCode and Dartfish) to be utilised. Dartfish was the primary tool (87%), whereas 60% and 87.5% of participants investigated by Wright et al.[26,27] utilised SportsCode. The ingrained use of a specific technology highlights that the aspiring analyst should aim to have a good knowledge of the main tool utilised within their desired environment; however, it was apparent that a wide variety of sports-specific tools were also frequently utilised. In contrast to Wright et al.,[27] but comparably to Wright et al.,[26] the majority of participants did not use an external information provider, inferring a considerably *hands-on* approach. Data reliability, specificity and the publicly funded nature of Olympic sport may offer further explanation to the lack of external information collation.

Academic literature, their findings and processes, currently plays an insignificant part within applied practice, as only 13% (compared to 39% for technological developments) of analysts stated they actively kept up to date with current developments as it was often 'not relevant'. Approximately 45% of analysts stated that they regularly liaised with analysts/academics regarding technological developments, whereas 30% did for literature. A large portion of research to date arguably focuses upon understanding the best at the expense of how this information can be implemented within applied practice.[23,34] Therefore, for practitioners to consistently implement research within the elite environment, research needs to better reflect the *real world* of elite sport by incorporating elite populations within investigations useful to them (i.e. practitioner or sport).

Conclusion

The findings add to the limited investigation outside of football/rugby union and provide detailed insight into the use and implementation of performance analysis within the Olympic feedback process. The majority of analysts stated their coaches' experience/philosophy impacted the direction of analysis they undertook. As such, the ability to develop an effective coach–analyst relationship in order to translate their philosophy/experience into measurable variables appears key to effective and impactful practitioner support. Time was the largest constraint upon the ability of the analysts to provide feedback. Furthermore, the quantity and content of feedback were highlighted as an underlying

factor to many of the analysts, consequently demonstrating the need for further research to address these concerns. Profiling was suggested as the second most used aspect of analysis (behind video); therefore, current or aspiring analysts should ensure that they are knowledgeable within profiling, specifically, what profiling is, how profiling is undertaken and how profiling can be illustrated/disseminated. The duration of feedback sessions currently provided was relatively varied and likely influenced by a number of variables, e.g. sport type (individual/team), situation (competition/training), content of the session (technical/tactical) and athlete (level/age/seniority). Academic literature was highlighted as playing an insignificant role within the analyst's applied practice. Consequently, research needs to make greater attempts to reflect the problems and questions that arise from the real world of elite sport. Closer collaboration between *the academic* researcher and *the applied* practitioner is therefore highly encouraged.

Not only does the study outline the 'what', it has extended upon current research through unearthing the 'how' and 'when' behind practice within Olympic/Paralympic sports providing a broad and detailed understanding of the implementation of performance analysis and feedback by practitioners within the applied environment. The insight gained into performance analysis practice has generated understanding of the various tools and delivery methods utilised, as well as the challenges faced by the applied practitioner on a daily basis. The questionnaire and subsequently, the information generated, could be shared between practitioners to assist within idea development, identify sports who operate in a similar or contrasting manner to enable discussion/collaboration, as well as being a means of 'checking and challenging' practice between environments. Moving forward, additional practitioner-based investigation utilising in-depth interviews with the overriding aim of unearthing the 'why' behind practice appears a key and obvious progression within future research. In addition, the investigation of performance analysis and feedback, (1) within other applied contexts and/or (2) within case-study approaches focusing upon a specific sport(s) may also positively benefit the development of future practice.

Overall, the use and analysis of empirical data have provided a more realistic representation of the environment. Moreover, the 'on the ground' nature of the study has highlighted some of the complexities that practitioners need to consider when delivering applied performance analysis and feedback support (e.g. the coach's philosophy and how this impacts upon what is analysed or how information is fed back to them). Consequently, it would appear prudent to investigate the use and value of feedback from the user's perspective, i.e. the coach, to more effectively meet the demands of those utilising the information to facilitate improvements.

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