Athletes' and Coaches' Perspectives of Performance Analysis in Women's Sports in Singapore

Joanne Kyra Loo[1,2*], John William Francis[2] and Michael Bateman[2]

[1] *National Youth Sports Institute, Singapore*

[2] *School of Sport and Exercise Science, University of Worcester, Worcester, United Kingdom*

Correspondence to: Joanne Kyra Loo, National Youth Sports Institute, 1 Champions Way, Singapore, 737913. Email: joanne_loo@nysi.org.sg

Athletes' and Coaches' Perspectives of Performance Analysis in Women's Sports in Singapore

To date, little consideration has been given to the context in which performance analysis (PA) is used by female athletes, in female sports and in an Asian context. Through the use of an online questionnaire and follow-up semi-structured interviews, the perspectives towards the use of PA and feedback by athletes and coaches in two female's sports in Singapore (water polo: one coach and 13 athletes; netball: one coach and eight athletes) were explored. Four key themes emerged from the inductive analysis of the data: (1) learning environment in teams, (2) considerations on the use of PA to aid development and learning, (3) application of game-related learning into practice through PA and (4) organisation of PA sessions: duration and design. The results indicated female athletes from Asian cultures welcomed group discussions, viewed information around areas for development in a positive light and were receptive to longer video reviews. Coaches and analysts should acknowledge the culture of the learner or group in addition to the session format when planning and delivering PA provisions to best meet the learners' needs.

Keywords: perceptions; water polo; netball; women; video analysis.

Introduction

Performance analysis (PA) has been seen as a useful tool for assessing tactical, technical and movement of performance during training and games (Nicholls, James, Bryant, & Wells, 2018). Since research identified that coaches could only account for 30% to 60% of the critical events that occurred in a performance (Franks & Miller, 1986, 1991; Laird & Waters, 2008)., PA has witnessed considerable growth within the past 20 years. This tool enables coaches to provide more accurate and meaningful feedback to athletes (Nelson & Groom, 2012; Stanway & Boardman, 2020). In addition, technological advances have enabled the use of PA to become increasingly more accessible to coaches and athletes all across the world (Dancs, 2020). Subsequently, these advances have enabled the performance analysts to capture, process and evaluate

large streams of video and data. In turn, allowing coaches, analysts and players to complete their own analysis and evaluation to aid learning, decision-making and future performance (Bampouras, Cronin, & Miller, 2012; Painczyk, Hendricks, & Kraak, 2017).

Several single-subject case studies have begun to paint a picture of how coaches, athletes or performance analysts perceive the various tools, techniques and value of PA (Bateman & Jones, 2019; Butterworth, Turner, & Johnstone, 2012; Francis & Jones, 2014; Groom & Cushion, 2004, 2005; Nelson, Potrac, & Groom, 2014; Wright, Carling, Lawlor, & Collins, 2016). Although these single-subject case studies are useful at providing an understanding relating to the use of PA within respective contexts, broader investigations, which capture the perceptions and practices of multiple uses in the PA process would offer a more thorough understanding of PA as a support tool in the coaching process (Nicholls et al., 2018). To this end, these broader investigations have been completed in association football, field hockey, netball, rugby union and Tae Kwon Do within the UK (Bampouras et al., 2012; Reeves & Roberts, 2013; Vinson, Beeching, Morgan, & Jones, 2017).

At present, the majority of the single-subject case studies and broader investigations exploring coaches, athletes and/or analyst perceptions towards PA, aside from some recent studies conducted by Moreno et al. (2016), Fernandez-Echeverria, Mesquita, Conejero and Moreno (2019) and De Martin Silva and Francis (2020), have focused on men's sports and from a male perspective. This phenomenon is historically explainable. When women first participated in the 1900 Paris Olympic Games, there were only two women's events and eleven female competitors (Mitchell, 1977). It took until 2016 for the number of female competitions to register a record high at the Rio de Janeiro Olympic Games (~45%) (International Olympic Committee, 2018). As the

Olympic Movement raises women's participation steadily, further understanding regarding the use of coaching tools in women's sports should be explored. In particular, PA research is needed to ensure the quality of performance in women's sport can parallel men's sport (Mclean et al., 2019).

From a coaching perspective, the tendency to refer to findings from men's sports when dealing with women's sports is largely due to the lack of gender-specific research. However, previous findings have revealed physiological and psychological differences between men and women within the same sport (Gomez, Barriopedro, & Alvaro, 2009; Gómez, Delaserna, Lupo, & Sampaio, 2014; Gómez, Lorenzo, Ibañez, & Sampaio, 2013; C.-M. Roberts & Forsyth, 2019). Within PA, Groom and Cushion (2005) identified male footballers' confidence and subsequent performance was adversely affected by the ratio of positive to negative video clips, specifically, if more negative clips were shown. Groom et al. (2011) emphasised this was particularly the case when performances were revealed in the presence of other athletes. Whilst, Fernandez-Echeverria et al. (2019) recently found only one out of 12 members of the female volleyball team reported feeling demoralised when the video of her poor performance was shown in team sessions. Although direct comparisons between these studies cannot be made, due to different populations, research design and other factors, the findings have highlighted the need for further research into how PA is perceived by female athletes.

Fernandez-Echeverria et al. (2019) study also highlighted the value of PA helping female athletes feel important, a valued member of the team and responsible for the team's future performances. Moreno et al.'s (2016) intervention study also highlighted the importance of an active process, through on-court and off-court questioning and video feedback. The athletes were subsequently able to process and

integrate more complex solutions. More recently, De Martin Silva and Francis (2020) added further support to an active PA process. The researchers found that over time and increased exposure to PA, female athletes evidenced an increased tactical knowledge base, increased performances as well as a greater sense of being part of a team. According to both the athletes and staff, the use of PA directly contributed to the development of positive culture and brought athletes and staff together. These findings are in contrast to the views of male New Zealand rugby players, where the team's coaches attempted to create an active process to encourage self-learning and self-discovery (Middlemas, Croft, & Watson, 2017). Instead, certain players never took part in discussions causing others to perceive this negatively impacted on the team's performance. These findings highlight the potential gender-based differences that exist when delivering a PA provision and when athletes receive corrective feedback.

With the above review considered, it highlighted the importance of understanding coaches' and athletes' perceptions of PA. The information collected, analysed and fed back pertains to their performances as well as the team's performance. From female athletes' and coaches' perspectives, these works have built on the positive views towards PA as a tool to help them develop as individuals by being open to both positive and developmental feedback. Also, the researchers and participants highlighted through the active and engaging PA process, athletes and staff were able to form effective coach-athlete-analyst relationships, which strengthen the culture, brought the team together and subsequently enhanced performance. Despite growing research in the use of PA and its benefits in the contemporary coaching process largely in a European context, there is a need to conduct similar research in an Asian context, which has a different sporting culture and environment (Patel, 2015, pp. 129-148; Zha, 2017).

When exploring coaching and learning approaches within Asia, Light (2005, p.41) reiterated the importance of recognising "how the cultural values and understandings that learners bring to lessons shape the ways in which they interpret and make sense of them". Athletes within Asian are often socialised into fitness conditioning, with the sporting environments encouraging conformity and compliance (McNeill, Sproule, & Horton, 2003). Individuals are less deferent and avoid behaviours that may be seen to cause negative connotations (Cheng, 2001). However, individuals within this collectivist environment are typically more holistic in problem-solving situations (LeFebvre & Franke, 2013). They focus on the context of the situation and draw on the relationships of those around them to produce an answer. Aspects of team sports deemed important for effective decision-making and overall performance. These differences to western cultures may present contradicting findings to those reported to date, whereby a tendency to be more individualist is found, despite attempts to encourage collaborative learning.

In an effort to bridge the current knowledge gap, this study attempted to gain greater insight regarding the use of PA in women's sports in Singapore from the athletes' and coaches' perspectives. The data gathered across two sports in an Asian context will be of value to several different national and international stakeholders involved in the sports performance eco-system. This research is of particular interest to the National Youth Sports Institute, Singapore and Singapore Sport Institute to inform PA service provisions across various sports regarding future planning.

Method

Following ethical clearance from a University's Ethics and Governance Committee and the Institutional Review Board of the Singapore Sport Institute, a two-phase approach was employed using a semi-structured online questionnaire, with open-ended and

closed-ended responses, followed by semi-structured interviews. The approach allowed athletes' and coaches' views and opinions of PA in two sports in Singapore to be explored.

Stage 1: Online questionnaire

Participants

A total of 21 athletes were chosen through a purposive opportunistic sampling method. The lead author had prior connections with the coaches of the two women's sports, namely an elite women's water polo squad and a netball Super League club in Singapore. Specifically, a total of eight netball athletes (26.2 ± 4.2 years old) and thirteen water polo athletes (22.8 ± 3.4 years old) completed an online questionnaire. All participants had experience using PA for a minimum of 12 months. The coaches used PA as part of training and competition periods with the athletes. In both sports, coaches and athletes used PA in three different modes: (1) pool or courtside sessions before training, (2) standalone classroom setting sessions (typically conducted on a non-physical training day or due to unforeseen circumstances) and (3) pre or post video reviews during competition. Before data collection, all the participants recruited to this study provided written informed consent and assent under the recommendations of the Declaration of Helsinki. All participants were informed of their rights to withdraw from the study at any time and their true identity protected via the use of pseudonyms.

Online Questionnaire

The online questionnaire was devised by a performance analyst (lead author) and two PA lecturers with 25 accumulative years' experience in the field. The questionnaire was based on previously used questionnaires by Francis and Jones (2014), Groom and Cushion (2005), Groom et al. (2011) and Wright, Atkins and Jones (2012) but adapted

to represent the participant's culture and sport. Also, the content was established via extensive observation and knowledge from the lead author regarding the use of PA within the two sports and informal discussions with the athletes, coaches and analysts.

The online questionnaire was piloted by an athlete and a coach who were not involved in the main data collection for the study. These individuals were chosen due to having more than two years of PA and sport-specific knowledge. The piloted questionnaire included a range of open-ended and close-ended questions. The close-ended questions utilised Likert scale items scored from 1-5 (5 being the highest score in terms of preference/importance/strongly agree and 1 being the lowest score in terms of preference/importance/strongly disagree) to represent the degree of the participants' preference and perception. Following the piloting process, proposed adaptations were discussed amongst the research team and the athlete and the coach who were all involved in the piloting of the questionnaire. Minor changes were made to reflect the terminology used by the teams in regards to learning environments, with the final online questionnaire consisting of 21 questions (excluding questions on demographics).

Procedure and data analysis

A link to the online questionnaire, hosted on a Google Form, was shared with all 21 athletes. Responses were received from all participants over three days and took approximately 10 minutes to complete. The online questionnaire responses were immediately made available to the research team. All data were processed using IBM SPSS Statistics 21 and descriptive statistics (frequency count and median (^)) computed to enable comparisons of perspectives between the two different sports. The opened-ended responses were extracted and included in the data analysis procedures for the interview data.

Stage 2: Semi-structured interview

Participants

After administration of the questionnaires and analysis of these findings, two athletes (Anna from water polo and Claire from netball), from the initial participants, and their respective head coaches (Louis from water polo and Sophie from netball; age: 42 and 37 years old; coaching experience: 22 and 18 years) were selected to participate in an initial semi-structured interview and a follow-up semi-structured interview. This stage of the research aimed to build on the strengths and overcome the weaknesses of both data collection tools.

Semi-structured interview

The interview guide consisted of questions for the initial interview and the follow-up interview. Within the initial interview, the questions were focused around (1) feedback and learning and (2) match preparation, key themes identified by Francis and Jones (2014), Groom and Cushion (2005), Groom et al. (2011) and Wright, Atkins and Jones (2012). These questions allowed real-life examples to be drawn-out, which was not possible within the questionnaire. In the follow-up interview, the emerging results from the questionnaire data along with further questions which examined the identified gender and cultural differences that had been highlighted by previous research (LeFebvre & Franke, 2013; McNeill et al., 2003) provided some direction when considering the questions. The interview schedule included 17 questions (11 initial interview questions and six follow-up interview questions) and was piloted by the same coach and athlete who completed the pilot questionnaire. Discussions were also held between the lead-author and the second-author to allay concerns over potential personal bias that the lead-author might have in terms of her own experience working as a performance analyst in this culture. No changes were made to the interview schedule,

but the lead author was encouraged to use further follow up questions to tease out additional responses and give more attention to exploring any gender and/or cultural differences which could exist during the follow-up interview.

All of the interviews involved asking open-ended questions about the use of PA and built on the findings from the questionnaire. Examples of the initial interview questions included, “can you describe the role you take in the feedback sessions?” and “could you describe how video-based analysis influences the way you or your team approach the match?”. Whilst the follow-up interviews asked questions such as “could you explain why you think the athletes’/teammates’ least preferred the classroom-type learning environment?” and “how do you feel your cultural upbringing influences your perception of PA?”.

Procedure and data analysis

The lead author conducted all of the interviews and adopted an ‘active listener’ role. She listened for the content, intent, and feeling of the participant's response and asked follow-up questions when appropriate to tease out further detail and understanding. These questions occurred in the form of clarification probes (e.g. what do you mean?), general probes (e.g. can you give me an example?), and elaboration probes (e.g. can you give me more details?). Although the participants were guided through an identical set of questions, the order of questioning varied dependent upon the direction and flow of the conversation taken by the participant as well as their role. Also, through the lead author having a prior rapport with the two athletes and coaches, it was hoped the participants would give open, honest and more in-depth answers. The initial and follow-up individual interviews were conducted by the four participants to fit around the participants training and playing demands. Both stages of the interviews were completed between March 2020 and May 2020. The total duration of the initial and

follow-up interview ranged from 44 to 59 minutes. The audio recordings were transcribed verbatim, yielding 32 pages of single-spaced text in total.

The content of each interview transcript and the open-ended questionnaire responses were exposed to thematic analysis; a data analysis method used recently by Fernandez-Echeverria et al. (2019). Firstly, the lead-author ascertained the accuracy of the transcribed data by immersing herself in reading each transcript and listening to the interview recording to become familiar with all aspects of the data. The lead-author began clustering quotes around underlying uniformities in PA and coaching into initial codes, centred on their relationship to the research aims.

Secondly, the lead-author segmented, categorised and compared the codes for similarities and differences to establish sub-themes. The emerging sub-themes were reviewed by the research team to ensure the identified sub-themes accurately represented the data as recommended by Martindale and Nash (2013). Also, peer debriefing was completed, as recommended by Lietz, Langer and Furman (2006), between the research team and the athlete and coach who had participated in the piloting process.

Following the consensus checking peer debriefing process, each sub-theme was refined and a definition of the sub-theme generated to ensure the overall presentation of the participants' perspectives remained in line with the research aims. As part of this process, the initial sub-themes were grouped into themes and key themes. Copies of the transcribed and coded interview transcripts were sent to the interview participants to verify accuracy and provide feedback on their interpretation. Once agreement had been reached, the research team deemed the key themes and themes to represent the main emerging topics that described how the participants' perceived the use of PA in women's sports in Singapore (see Table 1). The outlined processes completed by the

research team were key in reaching consensus regarding the findings and establishing credibility, dependability and transferability of the findings (Guba, 1981; Nowell, Norris, White, & Moules, 2017).

****Table 1 near here****

Results and Discussion

Whilst undertaking the analysis of the questionnaires and interview data, four key themes were identified and are discussed accordingly: (1) learning environment in teams, (2) considerations on the use of PA to aid development and learning, (3) application of game-related learning into practice through PA and (4) organisation of PA sessions: duration and design.

Learning environment in teams

The questionnaire data demonstrated the water polo and netball athletes agreed the 'pre or post video reviews of matches during competitions' was their preferred mode over the other learning platforms deeming this as either important or very important (see Table 2). It is important to note, however, the netball athletes did not differentiate their learning preference between 'pool or courtside sessions before training' from 'pre or post video reviews of matches during competitions'. These sessions, which were then directly applied to practice, were perceived to provide similar learning opportunities during training and competition phases. All athletes perceived the use of classroom-type sessions to be their least preferred learning platform and with several athletes viewing this mode as not important.

****Table 2 near here****

> “it's quite hard to really visualise it when you're in a classroom. I mean, you can see it from video analysis but, to put it into play is another thing. I recommend that you do it like 15 minutes before the training is rather helpful, just so that you can run through the piece on the court itself” (Claire)

The findings identified here align to those in Groom and Cushion's (2005) work whereby the classroom setting was the least preferred learning platform. Whilst the use of PA and online learning platforms are widely used in Western environments as an additional learning platform (De Martin Silva & Francis, 2020; Vinson et al., 2017), PA is a relatively new discipline in Singapore and restrictions on funding do not allow for additional tools to be used. Thus, these classroom setting sessions are still common despite Claire indicating a desire to actively learn.

Both teams also faced issues regarding limited space; the same facilities, particularly for netball, are often used by the public outside of the training sessions or competitions. Subsequently, the athletes typically went through a pool or courtside sessions at the training ground before their warm-up or at the competition venue before performing. They were, therefore, able to directly apply what they had learnt into practice. Predictably, this became a social practice of learning (Vinson et al., 2017; Vinson & Parker, 2019). As a result, the athletes may not perceive any contrast in the concept of learning space and hence the preference between the learning platforms. These findings also aligned with those of De Martin Silva and Francis (2020) who found discussions before training or competition to be more beneficial than formal coach-led sessions, enabling the athletes to learn in a supportive environment that was tailored to their needs and directly apply this learning into practice. Alternatively, the use of online learning platforms could provide a suitable option to overcome some of the aforementioned barriers. These platforms could enable athletes to engage in evaluating and reflection on performances and be used as an additional vechile to

encourage the sharing of ideas and discussions. These views were reinforced by the coaches, with Louis, the water polo coach, commenting on how the answers are not provided to the athletes but facilitate the discussions into a game:

> "Video analysis used to be a boring thing, we just watch the video and listen to the coach say and sometimes some of the athletes will just fall asleep- one-way traffic. So, the most important thing is not telling them your opinions because once you tell them your opinion, they will sway towards that... We try to make it into a game using a scoring system so that we make the discussion more interesting. So in the discussion, they will determine who score the point and who incurs demerit points. Actually, in this way, they will understand from the beginning what the problem is through their discussion." (Louis)

Indeed, the coach's philosophy influenced in shaping the learning environment (Côté et al., 1995). The coaches' views align to a constructivist perspective of coaching, whereby the role of the coach is to facilitate an active and engaging learning environment that scaffolds the learning of others (Potrac, Nelson, & Groom, 2016; Vinson & Parker, 2019). Furthermore, these findings also draw parallels to the Asia sporting culture, whereby a collective approach to problem-solving is adopted (McNeill et al., 2003). Nonetheless, from the athletes' perspective, the data and the theory align with the idea of a classroom setting, when analysing performance, is counter-productive to their learning. As highlighted by the netball athlete:

> "I try to lead the discussion, just to make sure that everyone is on the same page and let the juniors be a bit more comfortable in speaking up as well. If they feel there is something not right in what we are trying to do or what we could do better, it is best to discuss these aspects to find a solution." (Claire)

However, Anna, highlighted there is still disparity towards how athletes use the analysis to help them learn due to their age:

> "A lot of times during team meetings, a lot of nudging has to be given, a lot of encouragement has to be given for them, especially the younger ones. So even when I was younger, I don't dare to speak up because I was scared if I speak wrongly. I will be afraid. I think for us, it's more like I didn't have the confidence to speak up. Yeah, but if it is the right environment and if you nudge them enough, it would eventually, you know, come to the senses that even though I share these wrongly, I see things wrongly, it's okay. I learn from there and move on." (Anna)

According to Middlemas et al. (2017), these reflections from Anna towards younger athletes understanding of how to use PA are not uncommon. It could be argued the Asian culture results in these younger athletes avoiding behaviours that may be seen to cause negative connotations (Cheng, 2001). However, Nelson et al. (2014) inferred from John's reaction that young athletes' engagement in PA is not the issue, but more regards to how they use the technology and the environment the coaches have created when using analysis. Therefore, in agreement with Middlemas et al. (2017) and Nicholls et al. (2018), a significant part of an analyst's role should be regarding educating the end-users of the PA process. Also, the coaches acknowledged that their roles have evolved from the traditional practice, feeling a need to upskill themselves in the use of PA as a tool to support their delivery.

> "I will say in the past, this is not something that's actually common [discussion-based sessions]... it has evolved in a sense. Some coaches may still be quite traditional so they may not want to have the athletes to share amongst themselves- more of a directive approach- so they may not really want to advocate that kind of learning amongst the athletes. So for me, personally, when I started, it wasn't easy because I belong to the kind where I'm directive. So eventually, I also learned that it's important that the athletes also have a say, in certain things. And when I first started, it was harder because they would be very afraid to voice out their opinions. So it actually took quite a while for this team, particularly." (Sophie)

> "I've done quite a few like trial and error scenarios. I mean, what I used to do as a player when we go through the video analysis, it was really quite boring. You

> know, looking through the whole game, and the coaches talk, and then the players listen. So my thinking now is to find a more interactive and better way to actually present the video analysis." (Louis)

Unlike the findings in Groom, Cushion and Nelson's (2012) research, the results also demonstrated that beside coaches, the athletes can exert similar impact during PA sessions. These open discussions have been found to act as a means of facilitating an effective coach-athlete-analyst relationship, which maximises the PA process and optimises athlete learning (Bateman & Jones, 2019). Athletes, coaches and analysts are therefore seen as knowledgeable others (Vygotsky, 1987); learning from one another to co-create new knowledge to solve problems. However, for this is to occur, the environment has to be correct.

> "I'm glad that I have seniors that could also support me when I drive the conversations and when I post questions to the team, they were the ones who helped me quite a fair bit...They will break into simpler terms and help the younger team to answer those questions and make it less challenging in that sense. So it does help and slowly they begin to believe that okay, actually, there's nothing wrong to share what I think. It's not that typical of Asians culture in the past, but I'm hoping that more teams and more coaches will adopt such a culture." (Sophie)

> "The environment and the trust has to be there for players to buy-in and learn from one another. They know that it's really okay to make a mistake. There must be an understanding that to achieve something, there are many ways of doing it. Through seeing it on the video and applying it directly into practice seems to be best for the athletes and their learning" (Louis)

Also, gender differences, as also reported in Middlemas et al.'s (2017) work, could be a hindrance to active learning. Louis noticed the difference from his experience in coaching men:

> "if they (the women) reach a certain standard of cohesiveness, I think they are more autonomous than men, but men can work together regardless of the

> environment… With regards to men, I'm talking about if let's say, I tell them that you need to do this with this guy, he can. But sharing is entirely a different thing. Yeah, what I'm talking about is if I tell A and B even they are not good friends and say, look, the two of you need to make this work, they can. But if you are talking about sharing, that's another story." (Sophie)

Whilst these comments presented above highlight and reinforce several perspectives that begin to paint a picture as to understanding what makes an effective learning environment for these coaches and athletes, they highlight the stage in the development of understanding how to develop effective provisions in the two explored sporting contexts. As has been highlighted by researchers within an Asian context, the importance of relationships, which often extends beyond the main learning environment (Loh & Teo, 2017), appear to the cornerstone for enhancing learning. Therefore, continued attention on educating coaches as well as athletes in how to analyse and reflect on performances through the establishment and maintenance of relationships is required to maximise the use and efficiency of PA. Through this continued education, coaches and athletes will develop further confidence in developing and buying into an active and supportive learning environment whereby athletes can apply their learning from PA into practice (De Martin Silva & Francis, 2020; Vinson et al., 2017).

Considerations on the use of PA to aid development and learning

Almost all athletes reported all types of PA were important or very important in analysing the strengths and weaknesses of both the individual and the team (see Table 2). However, a tendency across both sports was observed regarding higher importance being placed on weaknesses over strengths. The data also indicated water polo athletes perceived PA produced a clear and unbiased visual context for the team whilst, in netball PA was seen as a tool to provide accurate reflection and specific evaluation of their performances. In both sports, the athletes displayed conviction and engaged in PA

to reflect on previous performances to aid future performances, as reflected by an open-answer response in the online questionnaire:

> "I do believe that videos help to analyse performance because it provides another angle of perspective that you can't really argue with. You can reflect and evaluate on your own performance and how it affected the team." (Questionnaire response from participant 1)

The views held by athletes and coaches reinforce the use of PA as a coaching tool to provide objective feedback to aid athletes' and coaches' understanding of individual and team areas of strength and areas for improvement (O'Donoghue, 2014, pp. 1-25). Similar views were also shared by the female Singapore athletes to the female volleyball players in Fernandez-Echeverria et al.'s (2018) study:

> "I think it was once, whereby we had actual feedback right after our 6 on 5 game. It was mainly like we were playing the 6 on 5, after that we immediately watched on the TV our positioning and how we played, how we moved, where was the gap that you did not see and everything and I think from then on, at least that session itself, we improved quite a bit. I felt that it was better, we reflected and then applied what we had seen to make us better." (Anna)

> "Treating those areas of weakness as development areas puts us - the team - on the same page. I guess sometimes we can be in our bubbles thinking that we didn't do anything wrong. But you actually see it on video and thinking, okay, I am going to do better. We then can discuss the possible ways to get better and hopefully can learn from our mistakes" (Claire)

Despite, similar tendencies being found in previous female PA research (Fernandez-Echeverria et al., 2018), differences have been observed within male PA research (Groom & Cushion, 2005). The findings from the current study add further weight to suggest male and female athletes focus on strengths and areas for development in a different light. In particular, the frequency counts found in this study highlight a

tendency for female athletes to focus on weaknesses whilst in the previously reviewed studies, male athletes largely focused on the positives of their individual and team performance. Previous comparison studies have found male athletes exhibited a higher ego orientation than their female counterparts (de Lira et al., 2010; Kavussanu & Roberts, 2001). Specifically, this resulted in the former placing less emphasis on learning and development processes. Although the coaches were of similar minds that male athletes tend to respond with an egotistic element, they agreed that the main concern lies in their personality, rather than gender.

> "It is not about male or female; it's more about their personality. If you are really Alfa-type of people, egoistic people, you probably want to see your strengths before your weakness." (Louis)

In the Asian context, the traditional high respect for moral education through formal lessons has also shaped how criticism is being perceived (Cheng, 2001), and may explain the tendency to focus on areas of development.

> "I would think that this is quite typical in Asian culture, for us [female Asian athletes] it's kind of like "Oh, I need to work on my weaknesses". Like I say, when you first come in, you kind of think I want to work on my weaknesses, rather than "Oh, this is what I can provide". In a sense, we're always told the things that we need to do better, that we are not so good at. For example, in school, you get told: "Oh, you need to buck up in your Maths". It's not like "Oh! You did very well in English." (Claire)

> "For Singaporeans, or rather in an Asian context, basically we can take criticism quite well. For me personally, when I was a player, I was under this particular teacher, the way she conducted sessions has probably impacted me. Back then, how when your parents scold you, you can't talk back. So it's the kind of mentality that we have in the past that, whatever that we have been scolded for, we just take in. I guess Asian culture wise I think now is still quite common. But we are trying to go into the direction of being more positive and giving more constructive feedback instead of just focusing on the weaknesses." (Sophie)

From one perspective, these findings could be argued to be a cultural trait. Individuals from a collectivist environment are typically more holistic in solving problems (LeFebvre & Franke, 2013) and persevere until the task is completed, due to their upbringing as children (Loh & Teo, 2017). Whilst, another angle to consider these findings is concerning gender. In contrast with Fernandez-Echeverria et al. (2018), the current findings found female athletes acknowledge their weaknesses and use these to identify areas to improve. Alternatively, despite gender and cultural similarities, it is how the coach, analyst and/or athletes frame the session and translate feedback that could affect individuals perspectives. Sophie shared a constructive feedback delivery method that echoed Macquet, Ferrand and Stanton's (2015) recommendation to adopt a transformational leadership style while debriefing the athletes.

> "I think through the videos when I actually prepare the clips, I may need to pick up more good things about them first. So use the hamburger approach - good things about them first - show them what brilliant stuff they have done, then tell them what they need to improve on, then wrap it up again with something that we have done well." (Sophie)

If these aspects are considered, how athletes see the benefits of learning from mistakes can be re-framed to aid their development, learning and performance through the use of PA (Groom et al., 2011).

Application of game-related learning into practice through PA

Except for one netball athlete, others perceived PA was either moderately important, important or very important to aiding their game understanding and influencing their decision-making processes (see Table 2). Water polo athletes reported higher preferences to all game-related aspects than netball athletes, except for the use of PA to aid attacking position without the ball. The importance preferences in the water polo

athletes towards PA as a tool to aid understanding of the team formation may be a result of how the sport is played. In water polo, each possession may take no longer than 30 seconds and there is no restriction to the areas of play as opposed to netball. Therefore, understanding the team formation as a whole seems practical, and of larger importance. Likewise, the observed difference reported on how PA had helped netball athletes understand their defensive play as compared to that of the water polo athletes, maybe the result of the different emphasis exhibited by the coaches. Lara-Bercial and Mallett (2016) highlighted how a coach's philosophy and vision along with the developmental background, the people they work with and the environment they operate in can affect what performance aspects an individual prioritises within the planning, delivery and evaluation of performance. This can be highlighted by a comment made by Sophie:

> "The top team's attack and shooting end are really strong. Defensively, we will be very much challenged. For us, we are clear in terms of team goals- what we want to achieve in the short season…we look into a lot more how we can overcome the opponents from stopping them being successful and that allows me to work on my team's strengths against them." (Sophie)

The coaches and athletes' preferences towards the use of PA as a tool to aid their game understanding aligns with a number of the previous studies, in a range of sports and across different genders. The questionnaire data was further supported by both athletes and coaches, enabling them to see a broader picture and develop game understanding:

> "When I first started playing, just watching the video itself, it helped me a lot; in terms of what I am seeing in the pool. Or there are different points of view that I don't see. So, from the video itself, it was quite obvious, some of the things. So it actually helps me build a concept of the game better." (Anna)

> "I mean as coaches, we can all roughly tell the style of the opposition and how they play but in terms of videoing. It helps a lot more because I can be telling my players verbally that this is how they play and at the same time I can pause and just

> tell them this is the moment that they can change the angle a little bit - how they can work on specific stuff. This is probably why it has helped a lot because we manage to win against a team of similar strengths to ours twice and get very close in winning the strongest team of the tournament. I thought that the main part that really helped me a lot is the tactical play and how it can enhance my knowledge. I thought that was the main part that added value to my approach." (Sophie)

Also, the ability to engage in collaborative discussions with coaches and teammates has been highlighted to increase learning, decision-making and understanding (De Martin Silva & Francis, 2020; Vinson et al., 2017). Whilst the use of PA will enable previous performances or training to be reviewed, what is performed on the court or in the ball in future performances may not truly align (Araújo & Davids, 2016). Therefore, the ability to discuss solutions to a range of scenarios and ensure other team members are aware of these possible solutions will result in athletes being equipped with superior decision-making skill to address the situations that may surface in a game. This perspective is shared by Anna:

> "Group discussions are useful to me because ultimately, I am playing with my teammates. So to understand a particular strategy, that the coach is trying to say, we can understand it as a whole what he's trying to do. But depending on who's your teammate and who you're playing with and all these will change accordingly to what your teammate can or what you can do, and to achieve that goal. So ultimately when you break down to group discussion, we can actually talk about how we want to do it to achieve that same goal. Mainly the coach will just say that okay, I want you to play this style but how we play this is not fixed by him, or it changes according to whoever we're playing with. So then, to be able to break down and come down into the group that you are supposed to work with can help with understanding what this thing is together as a whole, understanding what each other is supposed to play in that role, whether that be offensively or defensively to make us better." (Anna)

Furthermore, it is the role of the analyst and coach to provide and capture contextually specific information and feedback to aid this process and ensure athletes can translate the key messages based on historical events into future situations and scenarios. Whilst Araújo and Davids (2016) supports this notion, highlighting how PA can aid understanding of the coherent and dynamic individual and team behaviours to aid learning, a challenge remains in the discipline of PA regarding reducing these complex events and behaviours into singular metrics that can often become miss-interpreted and miss-used (Jayal, McRobert, Oatley, & O'Donoghue, 2018).

Organising PA sessions: duration and design

How coaches and/or analysts land those key technical and tactical messages, which promote player learning and decision-making, has been highlighted as components to consider within an analysis provision, in particular session duration (Groom et al., 2011). When exploring the actual duration and the preferred duration of PA sessions between netball and water polo athletes, differences were identified (see Figure 1 and Figure 2). In particular, water polo athletes typically perceived the current session durations were longer than the netball athletes. Whilst, preference for both sports was to have shorter PA sessions in the future. The actual and preferred length differ to those found in European studies and teaching research, which have indicated sessions should last no longer than 20 minutes (Francis & Jones, 2014). However, Bradbury (2016) argued the greatest variability in attention span arises from differences between who is attempting to maintain the learners' attention and not from the format itself.

*****Figure 1 and Figure 2 near here*****

Watching the entire water polo match was a typical approach but the coach inferred the duration was not fixed. It was dependent on the period of the season, which others have found as a factor that influences the duration of feedback.

> "An hour, an hour plus. Sometimes two hours depending... Usually at the beginning of the season is longer because towards the end things have rectified or most of the things have repeated and discuss. So, the session towards the end of the season will be shorter." (Louis)

However, the ability to maintain focus for up to two hours is counter-productive, with Wilson and Korn (2007) reporting an inverse relationship between the length of the session and the retention of the material covered.

> "To be honest, for me to watch for one whole match, I will drift in and out watching the videos and I see that there are people drifting in and out too… a lot of time, what we need to see at the beginning, after one hour later, maybe you might forget because there's too much information or at least after that one-hour session, the coach has to re-emphasise on what we need to focus on again" (Anna)

These views were shared by 50.0 % of the netball athletes and 61.5% of the water polo athletes who preferred the video session to be completed within 21-45 minutes in comparison to longer sessions. However, compared to the findings in Wright et al.'s (2016) study whereby more than 50% of the male football athletes preferred the video session to last within 11-20 minutes. The interpretation of the results could suggest female athletes may possess greater attention span and align with previous research by Thomas, Murphy and Hardy (1999). These researchers found female athletes had higher ability in applying attentional control than their male counterparts. Furthermore, individuals who have grown up in an Asian culture are often conditioned to longer teaching and training sessions (Loh & Teo, 2017). Thus, the ability for Asian athletes to concentrate for longer and join in with discussions may explain the preference surrounding longer sessions in comparison to European athletes, as summarised by Anna and Claire.

> "Whether this has something to do with us, always being questioned to sit down and study and then, you know, the attention span for the study has to be 3 hours long every time, maybe our studying culture is reflected in the sporting culture. Most of them are also still students, so they have that kind of attention span also and are used to it." (Anna)

> "I think it's the way we have to study. We don't mind just sitting there for close to an hour, just to do something. But I guess it's not just cultural-based but also the resource we have. To do performance analysis, you need to have quite a few support staff. Whether it means the videoing or tagging live, using the various software to ensure that these things are captured as soon as possible so it can be delivered with a player. In our culture, our coaches kind of do it all. The coaches have to take the video and tag it themselves. It takes a while, coaching itself takes up half a day and then you have to do all these. It's quite time-consuming if it's without support." (Claire)

Considering the resource constraints as noted in Claire's remark, the length of the PA sessions could also be because both coaches wished for the video preparation to be less time-consuming. As a result, the coaches would normally watch and focus the analysis on areas deemed key to the team's performance. Similar findings were found by Irish amateur coaches, who highlighted time and resources as key components that affected the coaches perceived value and time they could dedicate to PA (Martin, Swanton, Bradley, McGrath, & Bradley, 2018).

> "Because of time constraint that I have, and just making sure that I touch base with players and team at a personal level and in the right environment… So they will come in just before the warm-up and we will do that video viewing. In terms of the process, it is very tedious, I have to go look through every video clip to make sure I capture the right ones to evaluate their performance. So, time-wise is a bit tight because of the short period I have. I will do it on the Monday training and will spend like 20-30 mins sometimes to look at the individuals and sometimes is to look at the whole team." (Sophie)

Besides the external constraints identified by the athletes and coaches, which influenced the session duration, the relevance and practical benefits of using PA were the driving factors found in this study as well as previous research (Nelson, Cushion and Potrac, 2013; Martin et al., 2018). Also, as the coaches and athletes have mentioned, the idea of collaborative discussion-based sessions tend to take longer as the learner has to solve the problem rather than being provided with the answer (Benjamin & Keenan, 2006; Clyne & Billiar, 2016). Furthermore, the cultural norm in a collectivist society places a large emphasis on the coach to outline paths of learning (Loh & Teo, 2017), adopting the role as the facilitator (Vygotsky, 1987).

> "It depends on how advanced the video analysis is… as an athlete, we tried to digest the whole game and we just watched the game, we didn't break it down, but now because of the improvement in the knowledge in the analysis of the game, we start to categorise to different moment and different play and so that we hope it is easier to absorb. For the women's team, I also give them more autonomy. Sometimes I give them homework for them to go through. So they will go through about half an hour every Sunday, going through a certain video that they think is worth going through. It is what they feel that is worth watching for them to learn and sometimes I will just sit in and listen to their discussion. By listening to their discussion, it is also to check their understanding." (Louis)

With a greater understanding of the game, Louis felt he was able to delve deeper into a game, assisting learning pathways, but also involving athletes in discussions and giving autonomy. These findings connect to recent research, which highlighted the positive use of PA, collaborative learning and improvements in learning (De Martin Silva & Francis, 2020; Vinson et al., 2017). However, while the coach emphasised a learner-centred approach, Anna highlighted the duration of the session may be prolonged and the learning may be compromised if the PA session is engaged in an uncontrolled discussion. Thus, the differences identified above highlight the key role of a coach or

the analyst when delivering a session. Careful consideration regarding the structure (Groom et al., 2011), but also the overarching aim of the session is needed to find the balance between creative thinking and identifying an answer to aid player learning (S. Roberts & Potrac, 2014).

Conclusion

This study, which is the first to investigate the perspectives towards the use of PA by athletes and coaches in women's sports in Singapore, has contributed to an evolving body of knowledge in the field of perceptions towards PA. The findings of this comparative case study have demonstrated the similarities and differences between gender and culture when using PA as part of a team's training and competition programmes.

In particular, the classroom setting was the least preferred choice as a learning platform when receiving PA feedback. Whilst an active session immediately before training or competing was seen to be preferred by athletes. Even though PA plays a common role in identifying strengths and weaknesses for both water polo and netball, the extent of practical uses through game understanding depends on the nature of the sport. The Asian athletes within the study focused on their weaknesses as opposed to their strengths, viewing the learning opportunities as beneficial to their own and the team's future performances, highlighting the collective desire of the participants. Despite the disparity in the acceptable duration of video sessions between genders and cultural differences, it is imperative to scaffold a suitable learning environment that may affect session duration, which aligns with the longer duration found within the two sports. Furthermore, the athletes in this study welcomed the notion of collaborative learning, preserving together to reach a common goal or find a solution to the problem at hand, aligning with the historical views of Asian culture.

Despite these findings, there were several limitations to this study which should be noted. Firstly, the case study nature could be argued to be not substantial enough to provide detailed insights. However, our aim of the study was to provide a rich and detailed insight into the two sports use of PA within the Asia culture and not generalize findings to the entire Asian female elite sports population. Secondly, the study did not account for the level of support provided to the coaches in this study. Coaches without adequate support and education can seemingly spend less time using PA (Martin et al., 2018), which may have affected the views held by the coaches as well as the athletes towards PA. Thirdly, the data was collected over two different periods and therefore their views may have changed between the initial semi-structured interview and the follow-up interview. However, the complexities associated with collecting data from elite sports individuals has been well documented, and through clearly outlining the timeframes in the methods it is hoped the reader can clearly understand how the findings have been collected, analysed and interpreted.

Nevertheless, the findings from this study have provided a greater insight to the perceptions of PA within women's team sports in Asia and most importantly, deepen the knowledge and application for coaches to bridge the current gap of sports performance for women. It is, therefore, the role of the coach or analyst to carefully consider the overarching aims of using PA to assist in devising a suitable learning environment and session format. Also, individuals who are leading or overseeing the provision or a session should acknowledge the culture (collectivism or individualism) of the group to meet the learners' needs. However, without all users being educated into how to use PA, athletes having an important position in the process and effective relationship between the coach, athlete and analyst, the tool may become redundant rather than aiding coaching and athlete practice. In short, coaches and practitioners can

utilise the findings of this study to support and strengthen their own team's PA provision to maximise an active and engaging learning environment and continue to understand how to enhance current or future provisions.

References

Araújo, D., & Davids, K. (2016). Team synergies in sport: theory and measures. *Frontiers in Psychology*, *7*(1449), 1–13. https://doi.org/10.3389/fpsyg.2016.01449

Bampouras, T. M., Cronin, C., & Miller, P. K. (2012). Performance analytic processes in elite sport practice: an exploratory investigation of the perspectives of a sport scientist, coach and athlete. *International Journal of Performance Analysis in Sport*, *12*(2), 468–483. https://doi.org/10.1080/24748668.2012.11868611

Bateman, M., & Jones, G. (2019). Strategies for maintaining the coach–analyst relationship within professional football utilizing the COMPASS model: The performance analyst's perspective. *Frontiers in Psychology*, *10*(Article 2064), 1–12. https://doi.org/10.3389/fpsyg.2019.02064

Benjamin, C., & Keenan, C. (2006). Implications of introducing problem-based learning in a traditionally taught course. *Engineering Education*, *1*(1), 2–7. https://doi.org/10.1080/17500052.2006.11642153

Bradbury, N. A. (2016). Attention span during lectures: 8 seconds, 10 minutes, or more? *Advances in Physiology Education*, *40*(4), 509–513. https://doi.org/10.1152/advan.00109.2016

Butterworth, A., Turner, D., & Johnstone, J. (2012). Coaches' perceptions of the potential use of performance analysis in badminton. *International Journal of Performance Analysis in Sport*, *12*(2), 452–467. https://doi.org/10.1080/24748668.2012.11868610

Cheng, K.-M. (2001). Educational systems: Asia. In D. Sills (Ed.), *International Encyclopedia of the Social & Behavioral Sciences* (pp. 4333–4338). Pergamon. https://doi.org/10.1016/b0-08-043076-7/02395-0

Clyne, A. M., & Billiar, K. L. (2016). Problem-based learning in biomechanics: Advantages, challenges, and implementation strategies. *Journal of Biomechanical*

Engineering, *138*(7), 1–9. https://doi.org/10.1115/1.4033671

Dancs, H. (2020). Cooperation between performance analysts and sport data analysts. In M. Hughes, I. Franks, & H. Dancs (Eds.), *Essentials of performance analysis in sport* (3rd ed., pp. 407–410). London: Routledge.

de Lira, C., Vancini, R., Minozzo, F., Sousa, B., Dubas, J., Andrade, M., … de Silva, A. (2010). Relationship between aerobic and anaerobic parameters and functional classification in wheelchair basketball players. *Scandinavian Journal of Medicine and Science in Sports*, *10*(4), 638–643. https://doi.org/10.1111/j.1600-0838.2009.00934.x

De Martin Silva, L., & Francis, J. W. (2020). "It is like a little journey": Deaf international futsal players' and coaches' experiences in collaborative blended learning. *International Sport Coaching Journal*, *8*(2), 1–15. https://doi.org/10.1123/iscj.2019-0101

Fernandez-Echeverria, C., Mesquita, I., Conejero, M., & Moreno, M. P. (2018). Perceptions of elite volleyball players on the importance of match analysis during the training process. *International Journal of Performance Analysis in Sport*, *19*(1), 49–64. https://doi.org/10.1080/24748668.2018.1559544

Francis, J., & Jones, G. (2014). Elite rugby union players perceptions towards performance analysis. *International Journal of Performance Analysis in Sport*, *14*(1), 188–207. https://doi.org/10.1080/24748668.2014.11868714

Franks, I., & Miller, G. (1986). Eyewitness testimony in sport. *Journal of Sport Behavior*, *9*(1), 38–45.

Franks, I., & Miller, G. (1991). Training coaches to observe and remember. *Journal of Sports Sciences*, *9*(3), 285–297. https://doi.org/10.1080/02640419108729890

Gomez, M.-Á., Barriopedro, M., & Alvaro, J. (2009). Differences in playing actions between men and women in elite soccer teams. In A. Hoekelmann, K. Witte, & P. O'Donoghue (Eds.), *Current trends in performance analysis. World Congress of Performance Analysis of Sports VIII* (pp. 50–51). Magdeburg: Shaker Verlag.

Gómez, M.-Á., Delaserna, A., Lupo, C., & Sampaio, J. (2014). Effects of situational variables and starting quarter score in the outcome of elite women's water polo game quarters. *International Journal of Performance Analysis in Sport*, *14*(1), 73–

83. https://doi.org/10.1519/JSC.0000000000000234

Gómez, M.-Á., Lorenzo, A., Ibañez, S.-J., & Sampaio, J. (2013). Ball possession effectiveness in men's and women's elite basketball according to situational variables in different game periods. *Journal of Sports Sciences*, *31*(14), 1578–1587. https://doi.org/10.1080/02640414.2013.792942

Groom, R., & Cushion, C. (2004). Coaches perceptions of the use of video analysis: a case study. *Insight*, *3*(7), 56–58.

Groom, R., & Cushion, C. (2005). Using of video based coaching with players: a case study. *International Journal of Performance Analysis in Sport*, *5*(3), 40–46. https://doi.org/10.1080/24748668.2005.11868336

Groom, R., Cushion, C., & Nelson, L. (2011). The delivery of video-based performance analysis by England youth soccer coaches: towards a grounded theory. *Journal of Applied Sport Psychology*, *23*(1), 16–32. https://doi.org/10.1080/10413200.2010.511422

Groom, R., Cushion, C., & Nelson, L. (2012). Analysing coach-athlete "talk in interaction" within the delivery of video-based performance feedback in elite youth soccer. *Qualitative Research in Sport, Exercise and Health*, *4*(3), 439–458. https://doi.org/10.1080/2159676x.2012.693525

Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Communication and Technology*, *29*(2), 75–91.

International Olympic Committee. (2018). *Factsheet: Women in the Olympic movement*. Lausanne, Switzerland.

Jayal, A., McRobert, A., Oatley, G., & O'Donoghue, P. (2018). Sports analytics applications in soccer. In *Sports analytics: analysis, visualisation and decision making in sports performance* (pp. 220–244). Abingdon: Routledge. https://doi.org/10.4324/9781315222783-12

Kavussanu, M., & Roberts, G. C. (2001). Moral functioning in sport: An achievement goal perspective. *Journal of Sport and Exercise Psychology*, *23*(1), 37–54. https://doi.org/10.1123/jsep.23.1.37

Laird, P., & Waters, L. (2008). Eyewitness recollection of sport coaches. *International Journal of Performance Analysis in Sport*, *8*(1), 76–84.

https://doi.org/10.1080/24748668.2008.11868424

Lara-Bercial, S., & Mallett, C. J. (2016). The practices and developmental pathways of professional and Olympic serial winning coaches. *International Sport Coaching Journal*, *3*(3), 221–239. https://doi.org/10.1123/iscj.2016-0083

LeFebvre, R., & Franke, V. (2013). Culture Matters: Individualism vs. Collectivism in Conflict Decision-Making. *Societies*, *3*(1), 128–146. https://doi.org/10.3390/soc3010128

Lietz, C. A., Langer, C. L., & Furman, R. (2006). Establishing trustworthiness in qualitative research in social work: Implications from a study regarding spirituality. *Qualitative Social Work*, *5*(4), 441–458. https://doi.org/10.1177/1473325006070288

Light, R. (2005). Implementing understanding approaches to Teaching Games and Sport in Asia. *Asian Journal of Exercise and Sport Science*, *2*(1), 39–47.

Loh, C. Y. R., & Teo, T. C. (2017). Understanding Asian students learning styles, cultural influence and learning strategies. *Journal of Education & Social Policy*, *7*(1), 194–210.

Macquet, A. C., Ferrand, C., & Stanton, N. A. (2015). Divide and rule: A qualitative analysis of the debriefing process in elite team sports. *Applied Ergonomics*, *51*, 30–38. https://doi.org/10.1016/j.apergo.2015.04.005

Martin, D., Swanton, A., Bradley, J. J., McGrath, D., & Bradley, J. J. (2018). The use, integration and perceived value of performance analysis to professional and amateur Irish coaches. *International Journal of Sports Science and Coaching*, *13*(4), 520–532. https://doi.org/10.1177/1747954117753806

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

Mclean, S., Hulme, A., Mooney, M., Read, G. J. M., Bedford, A., & Salmon, P. M. (2019). A systems approach to performance analysis in women's netball: Using work domain analysis to model elite netball performance. *Frontiers in Psychology*, *10*(Article 201), 1–13. https://doi.org/10.3389/fpsyg.2019.00201

McNeill, M., Sproule, J., & Horton, P. (2003). The changing face of sport and physical

education in post-colonial Singapore. *Sport, Education and Society*. https://doi.org/10.1080/1357332032000050051

Middlemas, S., Croft, H. G., & Watson, F. (2017). Behind closed doors: the role of debriefing and feedback in a professional rugby team. *International Journal of Sports Science and Coaching*, *0*(0), 1–12.

Mitchell, S. (1977). Women's participation in the Olympic Games 1900-1926. *Journal of Sport History*, *4*(2), 208–228. https://doi.org/10.2307/43609254

Moreno Perla, M., Moreno, A., García-González, L., Ureã, A., Hernández, C., & del Villar, F. (2016). An intervention based on video feedback and questioning to improve tactical knowledge in expert female volleyball players. *Perceptual and Motor Skills*, *122*(3), 911–932. https://doi.org/10.1177/0031512516650628

Nelson, L., & Groom, R. (2012). The analysis of athletic performance: some practical and philosophical considerations. *Sport, Education and Society*, *17*(5), 687–701. https://doi.org/10.1080/13573322.2011.552574

Nelson, L., Potrac, P., & Groom, R. (2014). Receiving video-based feedback in elite ice-hockey: a player's perspective. *Sport, Education and Society*, *19*(1), 19–40. https://doi.org/10.1080/13573322.2011.613925

Nicholls, S. B., James, N., Bryant, E., & Wells, J. (2018). Elite coaches' use and engagement with performance analysis within Olympic and Paralympic sport. *International Journal of Performance Analysis in Sport*, *18*(00), 1–16. https://doi.org/10.1080/24748668.2018.1517290

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, *16*(1), 1–13. https://doi.org/10.1177/1609406917733847

O'Donoghue, P. (2014). What is sports performance analysis? In *An introduction to performance analysis of sport* (pp. 1–25). Abingdon: Routledge.

Painczyk, H., Hendricks, S., & Kraak, W. (2017). Utilisation of performance analysis among Western Province rugby union club coaches. *International Journal of Performance Analysis in Sport*, *17*(6), 1057–1072. https://doi.org/10.1080/24748668.2018.1429757

Patel, S. (2015). Race. In *Inclusion and exclusion in competitive sport: socio-legal and*

regulatory perspectives (pp. 129–148).

Potrac, P., Nelson, L., & Groom, R. (2016). Lev Vygotsky: Learning through social interaction in coaching. In L. Nelson, R. Groom, & P. Potrac (Eds.), *Learning in Sports Coaching: Theory and Application* (pp. 101–112). London: Routledge. https://doi.org/10.4324/9781315746012

Reeves, M., & Roberts, S. (2013). Perceptions of performance analysis in elite youth football. *International Journal of Performance Analysis in Sport*, *13*(1), 200–211. https://doi.org/10.1080/24748668.2013.11868642

Roberts, C.-M., & Forsyth, J. (2019). The Inaugural Women in Sport & Exercise Conference: Consensus statement. *Women in Sport and Physical Activity Journal*, *27*(1), 60–62. https://doi.org/10.1123/wspaj.2018-0045

Roberts, S., & Potrac, P. (2014). Behaviourism, constructivism and sports coaching pedagogy: A conversational narrative in the facilitation of player learning. *International Sport Coaching Journal*, *1*, 180–187.

Stanway, B., & Boardman, P. (2020). The analysis process: Applying the theory. In E. Cope & M. Partington (Eds.), *Sports coaching: A theoretical and practical guide* (pp. 93–108). London: Routledge.

Thomas, P. R., Murphy, S. M., & Hardy, L. (1999). Test of performance strategies: Development and preliminary validation of a comprehensive measure of athletes' psychological skills. *Journal of Sports Sciences*, *17*(9), 697–711. https://doi.org/10.1080/026404199365560

Vinson, D., Beeching, K., Morgan, M., & Jones, G. (2017). Collaborative evaluation of individual and team performance in training and match environments using the Coach Logic online platform. *International Sport Coaching Journal*, *4*, 47–62. https://doi.org/10.1123/iscj.2016-0048

Vinson, D., & Parker, A. (2019). Vygotsky and sports coaching: non-linear practice in youth and adult settings. *Curriculum Studies in Health and Physical Education*, *10*(1), 91–106. https://doi.org/10.1080/25742981.2018.1555003

Vygotsky, L. (1987). Thinking and speech. In R. Rieber & A. Carton (Eds.), *The collected works of L.S. Vygotsky* (pp. 39–225). London: Plenum Press.

Wilson, K., & Korn, J. H. (2007). Attention during lectures: beyond ten minutes.

Teaching of Psychology, *34*(2), 85–89. https://doi.org/10.1080/00986280701291291

Wright, C., Atkins, S., & Jones, B. (2012). An analysis of elite coaches' engagement with performance analysis services (match, notational analysis and technique analysis). *International Journal of Performance Analysis in Sport*, *12*(2), 436–451. https://doi.org/10.1080/24748668.2012.11868609

Wright, C., Carling, C., Lawlor, C., & Collins, D. (2016). Elite football player engagement with performance analysis. *International Journal of Performance Analysis in Sport*, *16*(3), 1007–1032.

Zha, M. (2017). Asian ethnic sports culture development is analysed. In *2016 National Convention on Sports Science of China* (pp. 1–4). https://doi.org/10.1051/ncssc/201701058

Table 1: Summary of the key themes and themes identified from the thematic analysis.

Key Themes	Themes
(1) Learning environment in teams	Delivery mode Supportive learning environment Active learning environment Encouragement Need to educate Relationships
(2) Considerations on the use of PA to aid development and learning	Examining strengths and weaknesses Evaluating performance Reflection on performance Impact of past learning Feedback delivery Timing of feedback
(3) Application of game-related learning into practice through PA	Differences in game modes Coaches philosophy Game understanding Tactical development Technical development
(4) Organisation of PA sessions: duration and design	Preferred duration Actual duration Feedback activity Session design

Table 2: Netball and water polo athletes responses regarding PA mode, what type of analysis they found useful and the practical use of PA for aiding game understanding and decision-making processes using a 5-point Likert-scale (^ = Median response).

	Sport	1	2	3	4	5
PA mode (1 = Least Preferred and 5 = Most Preferred)						
Pool or courtside sessions before training	Water Polo	0	2	2	4^	5
	Netball	0	0	1	4^	3
Standalone classroom setting sessions	Water Polo	3	3	1^	5	1
	Netball	2	0	4^	2	0
Pre or post video reviews during competition	Water Polo	0	2	1	2	8^
	Netball	0	0	0	6^	2
Types of useful analysis (1 = Least Important and 5 = Most Important)						
Individual Strengths (Technical Analysis)	Water Polo	0	0	2	6^	5
	Netball	0	0	2	5^	1
Individual Weaknesses (Technical Analysis)	Water Polo	0	0	1	5	7^
	Netball	0	0	1	4^	3
Team Strengths (Tactical Analysis)	Water Polo	0	1	1	4	7^
	Netball	0	0	0	5^	3
Team Weaknesses (Tactical Analysis)	Water Polo	0	1	1	2	9^
	Netball	0	0	0	3	5^
Potential applications of game-related learning: Game Understanding (1 = Strongly Disagree and 5 = Strongly Agree)						
Understanding the team formation (as a whole)	Water Polo	0	0	0	4	9^
	Netball	0	0	1	6^	1
Understanding my unit formation (in relations to my playing position)	Water Polo	0	0	0	5	8^
	Netball	0	0	0	5^	3
Helped me to understand our defensive playing style better	Water Polo	0	0	0	7^	6
	Netball	0	0	3	5^	0
Helped me to understand our offensive playing style better	Water Polo	0	0	1	7^	5
	Netball	0	0	0	6^	2
Potential applications of game-related learning: Decision-making (1 = Strongly Disagree and 5 = Strongly Agree)						
Helped me to select better defensive positions	Water Polo	0	0	3	8^	2
	Netball	0	0	4^	2	2
Helped me to be better in an attacking position (when I am without the ball)	Water Polo	0	0	1	9^	2
	Netball	0	0	0	5^	3
Helped me to select better passing options (when I am with the ball)	Water Polo	0	0	2	7^	4
	Netball	0	1	1	4^	2

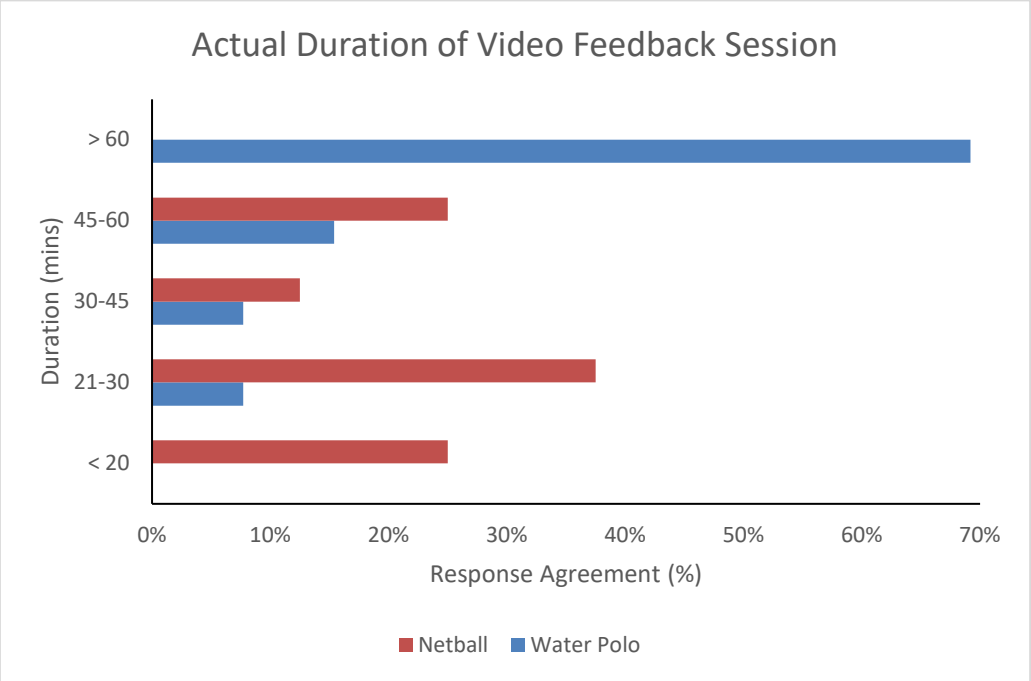

Figure 1. Athlete's perception of the actual duration of current performance analysis sessions.

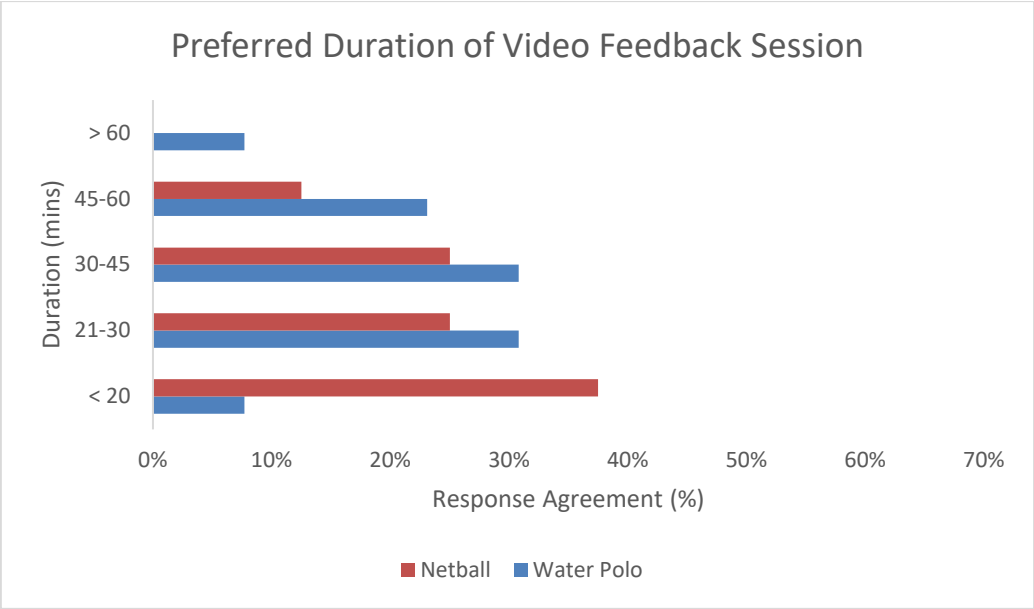

Figure 2. Athlete's preferred duration of future performance analysis sessions.