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 Feedback of GPS training data within professional English soccer: A comparison of decision making and perceptions between coaches, players and performance staff

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1   Original Papers

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3   **Feedback of GPS training data within professional English soccer: A comparison of decision**

4   **making and perceptions between coaches, players and performance staff**

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1   **Abstract**

2   The aim of the study was to examine the perceptions of training data feedback from key

3   stakeholders within the coaching process of professional soccer clubs. A survey assessed the importance

4   of training data towards reflection and decision-making, potential barriers and player preferences. 176

5   participants comprising coaches, players and performance staff completed the survey. The training data

6   coaches most commonly identified as wanting to see to support reflection was 'high-intensity' actions

7   and variables recognised by the coach as 'work rate/intensity'. All stakeholders reported training data

8   as at least somewhat important in guiding their coaches' practices, with lack of a common goal and

9   high volumes of information being the main barriers to effective feedback of training data. Players

10   deemed feedback as positive to changing their behaviour, with total distance, high-speed running and

11   sprint distances as the information they would most like to see. It would be likely to be looked at via

12   message or pinned up in the changing room. Training data is seen as an impactful and effective tool for

13   use by all key stakeholders. Despite this, its use can be optimised by increasing opportunities for

14   informal reflection, using less information, and improving communication of data.

15

16   *Key words:* Decision-making; Reflection; Evaluation; Coaches; Performance Staff; Players

1   **Introduction**

2   In professional soccer, the role of the coach is to improve their team's performance by planning

3   and delivering training sessions that allow the players to acquire the necessary qualities to triumph in

4   competition (Williams & Reilly, 2000). In order to improve performance, the coach must provide their

5   players with feedback (Williams, & Hodges, 2005; Ford, Yates & Williams, 2010) as well as making

6   many complex decisions, such as session content and team selection for an upcoming game.

7   Consequently, decision-making is considered a very important aspect of the successful coaching

8   process (Cushion, Nelson, Armour, & Lyle, 2010; Mata & Gomes, 2013).

9   To improve players physical performance, many professional soccer clubs employ performance

10   staff (e.g. sport scientists) to collect, analyse and feedback training data (e.g. total distance, sprint

11   distance, high-speed running etc.) from players (Akenhead & Nassis, 2015) via methodologies such as

12   global positioning systems (GPS). This information can be subsequently used to evaluate and improve

13   current practices and decision-making (Buchheit, 2017; Robertson, Bartlett, & Gastin, 2017; Ward,

14   Windt, & Kepton, 2019). For example, training data collected by performance staff through GPS has

15   previously been illustrated to help form a range of measures that may identify injury risks (Rossi et al.,

16   2017) and changes in physical qualities (Clemente, Nikolaidis, Rosemann, & Knechtle, 2019). Though

17   the potential impact of collecting training data is becoming clearer, further research is required to

18   understand specifically whether this feedback is utilised to support coach decision-making.

19   Integral to the decision-making process is the ability of the coach to reflect on past and current

20   experiences to generate new knowledge and improve coaching quality (Cooper & Allen, 2018; Stodter

21   & Cushion, 2019). The reflective process can evaluate whether a desired change has occurred alongside

22   performance outcomes and coaching technique (Cooper & Allen, 2018). Furthermore, it has been

23   shown that feedback to coaches via video-stimulated recall enhanced the use of reflection and coaching

24   behaviour change, perhaps due to the provision of a structure for reflective practice and increased self-

25   awareness (Partington, Cushion, Cope, & Harvey, 2015; Stodter & Cushion, 2019). Though the use of

26   reflection in the coaching process is well understood, the use of feedback of GPS training data to

27   facilitate this reflection is not.

1   In order to better understand the impact of feedback of GPS training data on the coaches

2   decision-making process, those involved in this process should be considered (Greenwood, Davids, &

3   Renshaw, 2012; Cooper & Allen, 2018). Previous work examining coaches and performance staff

4   perceptions of training data, such as that collected via GPS has shown that though coaches have an

5   awareness of sport science, they perceive this data as only fourth in their interests behind mental and

6   physical skills in addition to group dynamics (Brink, Kuyvenhoven, Toering, Jordt, & Frencken, 2018).

7   Moreover, despite a level of agreement between coaches and performance staff in terms of the

8   usefulness of load monitoring, coaches only reported that training is sometimes altered based upon

9   training load data. Practitioners reported GPS as the most utilised method (22%) for training monitoring

10   and data collected was perceived as positive. A large proportion of practitioners (84%) perceived it as

11   beneficial to their club (Weston, 2018). Clear gaps exist with reference to how coaches use GPS training

12   data to reflect and evaluate their sessions and make decisions to influence the coaching process.

13   Though the above research show that both coaches and practitioners find training data feedback

14   valuable (Buchheit, 2017; Weston, 2018), it is important to understand the perceptions of players in the

15   use of GPS training data. Players play a fundamental role in the decision-making process as lack of

16   feedback to them has been shown to be attributed towards a disengagement with the practices of training

17   data feedback (Neupert, Cotterill, & Jobson, 2019). For example, rugby union players valued video

18   feedback to identify areas of weakness to improve on (Francis & Jones, 2014). To date, perceptions

19   towards feedback of GPS training data has not been examined.

20   To that end, the aim of the present study was to examine the perceptions of GPS training data

21   feedback from key stakeholders included in the coaching process (i.e. coaches, performance staff and

22   players) of professional soccer clubs. Moreover, a second aim was to understand how feedback of GPS

23   training data influences decision-making processes and reflections of the coach. Findings from this

24   study may inform future practice of sports science provision within professional soccer.

25

26   **Methods**

27   *Participants*

1   A total of 176 participants comprising coaches, performance staff and players currently

2   working in professional soccer voluntarily completed an online survey. Participants were recruited

3   using a poster advertised on social media platforms Twitter and LinkedIn and directly through the

4   research team's network of contacts. In order to increase visibility and utilise 'snowball sampling'

5   (Morgan, 2008), participants were encouraged to circulate the poster to their personal networks and

6   peers. The survey was first made available on the 23rd November 2018 and was open for approximately

7   20 weeks, with social media promotion every 4 weeks. Inclusion criteria defined that participants were

8   working in professional soccer at the time of data collection and were utilising GPS systems in their

9   practice. In the present study, the survey was not limited to one response per team for each of the cohorts

10   given the large number of squads within each professional club (e.g. from youth team to senior/first

11   team). Players were required to be 18 years old or above. All participants were able to view and

12   download the participant information sheet on the first page of the survey and were advised that by

13   taking part their informed consent was given. To ensure that responses were collected from targeted

14   populations, exclusion criteria was provided on the first page of the survey and no information regarding

15   participant age, gender or club was requested thus they remained confidential. The procedure was

16   ethically approved by the local ethics committee of the host university.

17

18   *Survey design and distribution*

19   Three separate surveys were created, with one for each group of participants. Surveys took an

20   average of three to five minutes to complete and responses were anonymous with no identifiable

21   information requested. Surveys began with a glossary of terms which classified GPS as "*the unit*

22   *typically worn by soccer players in a vest during training and matches that captures information*

23   *regarding a players movements*" and training data as "*the information collected by the GPS units during*

24   *training and match play, such as distances in different speed zones*". This was followed by a number

25   of closed-ended questions examining participant demographics and a number of key topics relating to

26   the use of training data in the coaching process including: (1) Training session reflection and evaluation

27   examined the logistics of how training sessions are evaluated and how training data is utilised in this

28   process while questions regarding the importance of training data examined the perceived influence of

1 collected data on coaches and performance staff practice; (2) Sources of information used to design

2 practice to see how training data compares to other sources while barriers to training data use aimed to

3 gain a deeper understanding of possible causes of a translational issue between training data and the

4 coaching process; (3) Impact on players examined the potential behaviour change of players following

5 feedback of their data. Some questions were specific to each group of participants while some questions

6 were the same to allow comparison across the groups. Questions included multiple-choice and Likert

7 scale responses on a 5-point scale with all points labelled with anchors (Wade, 2006). A free-text

8 response option was added to questions where required, allowing for respondents to provide context

9 around additional information. Despite this option, no participants needed to add such extra detail

10 meaning that no analysis of free-text data was required. Questions were developed by the lead

11 researcher and were based on experience and relevant literature (Wright, Atkins, & Jones, 2012;

12 Akenhead & Nassis, 2015; Stoszkowski & Collins, 2016). The survey was reviewed for content validity

13 (Stoszkowski & Collins, 2016) via three rounds of group discussions with the research team. Two

14 rounds of pilot testing were performed though discussion with two coaches (one coach and one assistant

15 manager), three players (all playing for a U-23 development squad) and three performance staff (one

16 physiotherapist and two sport scientists) working in an English Premier League club. This resulted in

17 the modification of the wording of several questions to enhance readability/understating (coach = 3;

18 performance staff = 2; player = 2) which were readdressed and approved by the same stakeholders. The

19 surveys were uploaded to the online survey platform Survey Monkey (Survey-Monkey, California,

20 USA). The final surveys consisted of 14 items for coaches, 14 items for performance staff, and 8 items

21 for players.

22

23 *Data reduction and analysis*

24 Responses from Survey Monkey were exported into Microsoft Excel and subsequently SPSS

25 (version 25, IBM, New York, USA) for further analysis. For categorical and multiple-choice questions,

26 frequency analysis was conducted with the percentage of respondents reported for each response. To

27 assess for between-group differences in these responses, a proportion ratio was used (Hopkins, 2010)

28 as per Weston (2018). Qualitative inferences trivial, small, moderate, large, very large and extremely

1   large were represented by the ratios 1.00, 1.11, 1.43, 2.0, 3.3 and 10 respectively, with their inverses

2   represented by ratios of 0.9, 0.7, 0.5, 0.3 and 0.1 (Hopkins, 2010).

3   Likert scale responses were converted to integers and represented by the qualitative anchor

4   associated with the mean response (Hopkins, 2010). Between-group differences were reported as

5   differences in the mean response with 95% confidence intervals. An independent t-test was used to

6   assess for statistical significance in these differences. This information, in addition to a smallest

7   worthwhile change of 1-point in the Likert scale, was input into a custom-made spreadsheet (Hopkins,

8   2007) to allow for a yes/no interpretation of a clear between-group difference.

9

10   **Results**

11   *Participant demographics*

12   Of the 176 participants who took part in the study, 35 were coaches, 79 were performance staff

13   and 62 were players, this distribution was similar to that previously seen in the literature (Weston,

14   2018). The coaching staff group consisted of coaches (6%), assistant coaches (17%), managers (11%)

15   and assistant managers (11%). Performance staff were predominantly sport scientists (54%), strength

16   and conditioning coaches (17%), and medical staff (17%) such as physios and doctors. Performance

17   analysts (5%) and other roles (7%) such as sport science analysts made up the rest of the group.

18   Demographics of participants can be seen in **Table 1**. The majority of coach staff worked with English

19   Premier League clubs (35%), whereas performance staff worked with English Championship clubs

20   (38%), players were more evenly distributed across leagues. Furthermore, the majority of participants

21   were responsible or played for first team or professional development phase groups (87%).

22

23   Insert **Table 1** here.

24

25   *Importance of training data*

26   Coaches and performance staff reported that sport science training data was 'somewhat

27   important' and 'very important' in guiding their own practice, respectively (**Table 2**). In terms of

28   guiding the coach's practice, players rated it 'very important' while performance staff suggested it was

1 'somewhat important'. All groups of respondents selected 'player fitness', 'injury prevention' and

2 'assessment of effort' as 'very important' with which sport science data contributes greatest to. Players

3 and performance staff also reported 'planning training' as 'very important'.

4

5 Insert **Table 2** here.

6

7 *Reflection and evaluation*

8 The majority of coaches reported reflecting with other coaches either 4 to 5 times (38%) or > 5

9 times (44%) per week whereas performance staff response were distributed between once per week

10 through to > 5 times per week (**Table 3**). When detailing when this typically takes place, coaches

11 selected 'in the morning before training' (82%), 'no specific timing structure' (74%), 'immediately

12 following training' (50%) and 'after concerning events' (47%) most frequently while performance staff

13 selected 'in the morning before training' (59%), 'no specific timing structure' (55%) and 'after

14 concerning events' (49%) most frequently. Coaches found that the use of sport science training data in

15 this reflective process was 'somewhat important' while performance staff viewed it as 'very important'.

16 The most selected information coaches wanted to see to support reflection was 'high-intensity actions'

17 (82%), 'work rate/intensity' (74%) and 'comparing physical outputs to what players do in a match'

18 (59%). Similar responses were recorded for performance staff who also selected 'individual player

19 workload' (77%) frequently.

20

21 Insert **Table 3** here.

22

23 *Barriers to use*

24 Coaches 'agreed' that 'too much information', 'poor communication from sport science

25 department' and 'lack of a common goal' were barriers to using sport science data to inform their

26 practice (**Table 4**). Performance staff however, only 'agreed' that 'lack of a common goal' was a barrier

27 for their coach.

28

1   Insert **Table 4** here.

2

3 *Players perspectives of feedback*

4   Most coaches (59%) and performance staff (63%) indicated that players could be affected in a

5 positive manner following seeing their training and match data while approximately a third of both

6 groups (coach = 35%, performance staff = 36%) suggested that players could be affected in both a

7 positive and negative manner (**Figure 1a**). In response to whether players would alter their future

8 behaviour as a result of seeing their data, the majority of coaches (94%) thought they would while most

9 performance staff (75%) also thought they would (**Figure 1b**). Players most frequently selected 'total

10 distance' (89%), 'high-speed running and sprint distances' (87%) and 'maximum speed reached' (73%)

11 as the information they would like to see following a training session (**Table 5**). Players selected

12 'against players in your position' and 'against a typical 90-minute match' most frequently in terms of

13 how they wanted to see training data compared following training. This information was most likely to

14 be looked at if it was either 'pinned up in the changing room' or 'sent to your phone'. Players reported

15 they were 'likely' to change their effort levels in response to both seeing their data after a session and

16 seeing their data live during the session.

17

18   Insert **Figure 1** and **Table 5** here.

19

20 **Discussion**

21   Findings from the present study develop our knowledge of the use of training data within

22 professional soccer. Stakeholders deemed training data as somewhat important to guiding their coach's

23 practice, with 'high-intensity actions' and variables recognised by the coach as 'work rate/intensity' as

24 most important. Furthermore, for the first-time, players perceptions of this practice were explored. To

25 increase the prospect of behaviour change, players desired to see total distance, high-speed running and

26 sprint distances. Finally, several barriers potentially exist such as communication and lack of a common

27 goal result in limiting translational effects between data collection and training modifications.

28

1   *Importance of training data*

2   All stakeholders reported training data as at least somewhat important in guiding their coach's

3   practices (**Table 2**). As expected and consistent with the literature (Weston, 2018), given their

4   responsibility of the physical attributes of players, performance staff reported training data of higher

5   importance. All stakeholders reported that training data is deemed most important for player fitness and

6   injury prevention (**Table 2**). This understanding suggests coaches likely consider the dose-response

7   relationship when programming training loads to account for player fitness and injury risk (Manzi,

8   Bovenzi, Impellizzeri, Carminati, & Castagna, 2013). This is as the 'dose' of training has potential to

9   yield positive (i.e. fitness) and negative (i.e. fatigue) responses, which may be valuable for training

10   design. This suggestion is further supported by all stakeholders deeming training data important to the

11   planning process (**Table 2**). While research exists showing a dose-response relationship between

12   training load and injury risk (Rossi, et al., 2017), research examining training load and fitness measures

13   reports little usefulness. For instance, unclear associations between high-intensity running distances and

14   changes in intermittent running capacity were reported by professional soccer players across pre-season

15   (Taylor et al., 2017; Rabbani et al., 2019). In contrast, several studies have reported associations

16   between internal load measures provided by heart rate-based indices and changes in fitness (Akubat,

17   Patel, Barrett, & Abt, 2012; Manzi et al., 2013; Taylor et al., 2017). Given the above, it could be

18   suggested the effectiveness of training data feedback provided to coaches using measures of load solely

19   from GPS on player fitness requires further research.

20

21   *Reflection and evaluation*

22   Reflection and evaluation of training sessions represents an ideal opportunity to feedback

23   training data, and both coaches and performance staff reported that the data is valuable in reflection

24   (**Table 3**). There was also agreement on what data coaches preferred and what performance staff were

25   likely to report. Measures relating to high-intensity actions (Coaches; 82%, Performance; 94%) and

26   work rate/intensity (Coaches; 74%, Performance; 79%) were most frequently selected (**Table 3**). This

27   may be due to the observed increases in the physical demands of soccer. For example, from 2006 to

28   2013, soccer players from the English Premier League increased high-intensity sprint distances and

1   actions by 30-80% (Barnes, Archer, Hogg, Bush, & Bradley, 2014). These parameters may have been

2   chosen as they allow coaches and performance staff to compare training and match loads (Kelly,

3   Strudwick, Atkinson, Drust, & Gregson, 2019) which helps contextualise the data fed back to coaches.

4   Though coaches and performance staff deemed training data valuable, within-department

5   reflection and evaluation occurred more frequently than inter-departmentally. This within-departmental

6   reflection mostly occurred via morning meetings and informal conversation (**Table 3**). This finding is

7   consistent with the literature (Stoszkowski & Collins, 2016), which suggested that coaches prefer peer

8   discussion as a method of learning. Typically, most departments do not share office space consequently,

9   therefore limiting the opportunity for between-department discussion. This reduction in between-

10   department discussion may reduce impact feedback of training data has in supporting coach learning

11   therefore limiting impact on the coaching process.

12

13   *Barriers to use*

14   Though feedback of training data has shown to be effective, barriers exist that can reduce its

15   efficiency. As can be seen in **Table 4**, coaches and performance staff were in agreement that a lack of

16   a common goal was the main barrier to effective training data feedback. Research has consistently

17   shown a relationship between injury and fatigue (e.g. Rossi et al., Thorpe et al., 2017) as well as fitness

18   (e.g. Manzi et al., 2013; Taylor et al., 2017). Consequently, it could be suggested that both coaches and

19   performance staff work together to reduce training load rather than increasing players physical output.

20   If such actions conflict with the coach's philosophy (Stodter & Cushion, 2017), this may present a

21   barrier towards impact on the coaching process and thus it may be the responsibility of sport scientists

22   to educate coaches to aid this adoption and use. A further barrier to feedback of training data from

23   coaches is high volumes of information coupled with poor communication from performance staff

24   which highlights the transitional gap between information and impact (Eisenmann, 2017). Recently a

25   number of interventions have been shown to have a positive effect on quantity and quality of training

26   data feedback (Thornton, Delaney, Duthie, & Dascombe, 2019). For example, a colour coding system

27   has been previously employed to reduce the volume of information to indicate an athlete's performance

1   and availability (Robertson et al. 2017). Such delivery of feedback is crucial to the coaching processes

2   and further research is needed to reduce these barriers.

3

4   *Players perspectives of feedback*

5   Crucial to the coaching process are the players themselves, as such, training data feedback

6   provided to players should also be considered. This feedback can be promotion (positive) or change

7   oriented (negative), and the effects of which depend on delivery method (Deci, Koestner, & Ryan,

8   1999). Results showed the majority of coaches and performance staff thought players could be affected

9   in a positive manner by seeing training data (**Figure 1**) whilst also suggesting players may change future

10   behaviour following both concurrent and post-session feedback (**Table 5**), which has previously been

11   observed in rowing (Lintmeijer, Knoek van Soest, Robbers, Hofmijster & Beek, 2019) and weightlifting

12   (Wealey et al., 2019). Furthermore, the data in **Table 5** and **Figure 1** support previous research from

13   performance analysis where youth soccer players and rugby players reported video analysis as a useful

14   reflection and learning tool to identify and improve on weaknesses (Francis & Jones, 2014). This is the

15   first study to explore how professional soccer players might respond to feedback of training data.

16   Research exploring their attitudes and whether behavioural changes occur as a result of receiving

17   feedback of training data would further develop this understanding.

18   A potential barrier to the use may be their understanding of training data relates to their

19   performance. As can be seen in **Table 5**, total distance, total distance, sprint distance and high-speed

20   running were considered most important to players. Despite acceleration variables being one of the

21   most reported by performance staff (Akenhead & Nassis, 2015) it was considered least important to

22   players. In terms of how to feedback the training data, players preferred their data to be in comparison

23   with players in a similar position, thus promoting competition and possibly motivation. The data is also

24   most likely to be understood if it was sent to their mobile phone or pinned in the changing room,

25   suggesting ease of access to players plays a crucial role in the feedback process. These findings offer

26   initial insights into players perspectives of feedback of training data and in doing so, may reduce barriers

27   previously shown to result in poor engagement with the training monitoring process (Neupert et al.,

28   2019).

1   *Limitations*

2   The present study had responses from 176 participants. Though higher responses tend towards

3   findings with greater external validity (Baruch & Holtom, 2008). This sample is low compared to the

4   hundreds of coaches and performance staff together with the thousands of players within professional

5   soccer and therefore must be acknowledged when generalising these results. To provide context for the

6   surveys response rate, this number is similar to (Weston, 2018; $n = 182$) though more than (Akenhead

7   & Nassis, 2016; $n = 41$) in other studies that utilised surveys to examine stakeholder's perceptions of

8   training monitoring. Furthermore, in this study we used a convenience sample (i.e. personal networks)

9   and did not approach all key stakeholders within English professional soccer. Though limiting a survey

10 to one response per team ensures that the findings are not influenced by multiple responses from the

11 same team (Harper, Fothergill, West, Stevenson, & Russell, 2016). In the current study more than one

12 response was allowed given the large number of squads within each team in professional football.

13 Consequently, the possibility for clustering of responses has been acknowledged though accepted so as

14 to gain a greater environmental understanding. Finally, the focus of the present study was key

15 stakeholder perceptions on feedback of training data collected via GPS. Professional soccer clubs use

16 other methods to collect training data such as heart rate or rating of perceived exertion. Therefore, the

17 data on the present study should not be generalised to all training data collected in professional football.

18 Future studies should seek to understand perceptions and decision-making of key stake holders

19 (coaches, performance staff, players) on other methods of collecting training data.

20

21 *Conclusion*

22   The present study examined how the feedback of GPS training data is utilised to support

23 decision-making in the coaching processes, as well as understanding players perceptions towards this

24 training data. Training data is seen as an impactful and effective tool for use by all key stakeholders.

25 Despite this, its use can be optimised by increasing opportunities for informal reflection, using less

26 information, and improving communication of data. Further research is needed to examine feedback

27 mechanisms of training data to coaches is needed.

28

1   *Practical applications*

2   All key stakeholders generally support the notion that feedback of training data plays a role in

3   supporting the coaching process. Findings from the current study indicate that players would modify

4   their behaviours based on the data fed back to them, therefore it is important for practitioners/coaches

5   to understand their feedback preferences to increase the engagement. Further study is required on the

6   translation between data collection, self-autonomous behaviour, and future physical performance in

7   training. To improve the effectiveness of feedback of training data and its use to inform practice it is

8   important to address the potential barriers that exist. It could be recommended that performance staff

9   reduce the amount of information provided to coaches yet ensuring that the correct data to inform

10 effective decision is included. One way to achieve this may be by adopting data reduction tools such as

11 principal component analysis (PCA), a technique that reduces the dimensionality of data set (i.e. GPS

12 data) that consists of a number of highly correlated variables. This technique has proved highly effective

13 reducing the complexity of training data in team sports such as rugby league (Weaving, Beggs, Dalton-

14 Barron, Jones, & Abt, 2019), yet data in professional soccer is currently missing.

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1   **Figure Captions**

2

3   **Figure 1. (a)** Do you believe that players are mostly affected in a positive or negative manner by seeing

4   their training and match data? **(b)** Do you think that players may alter their behaviour in training due to

5   this? Coaches answers are presented in the black columns and performance staff answers in the light-

6   grey columns.

7

A

B

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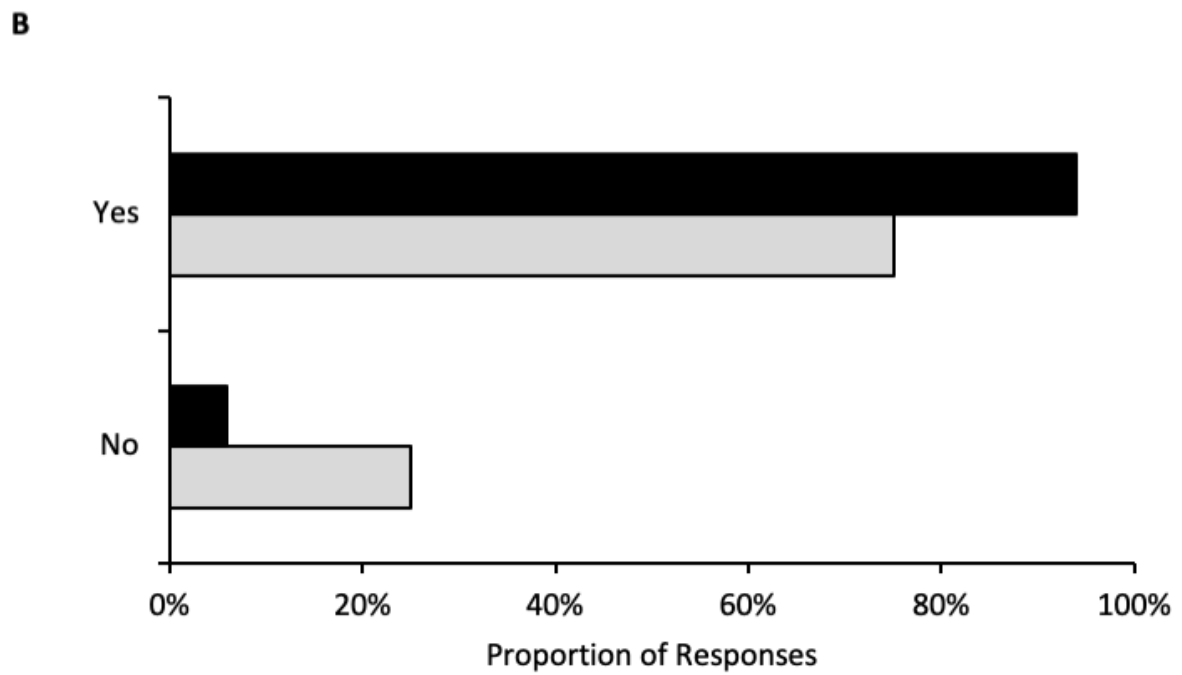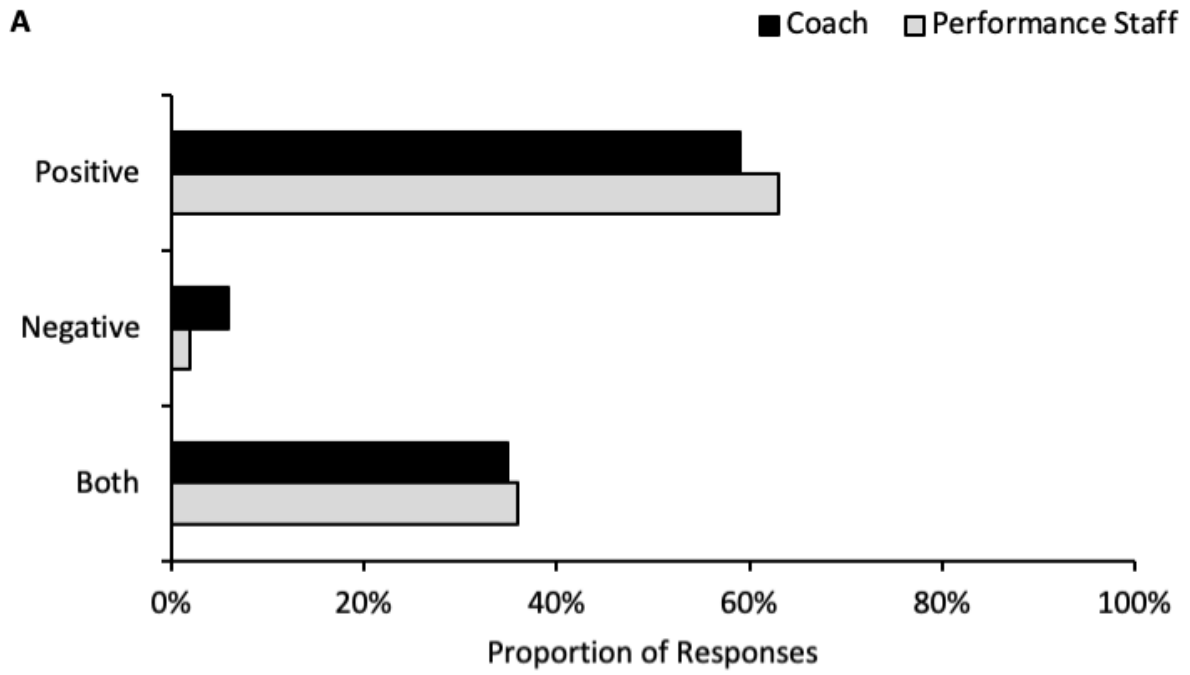
3 **Table 1**. Proportion of league clubs worked with, player age categories and years' experience by the
4 participants. Also included are the ratio of proportion (C:PS; C:P; PS:P) and qualitive inference for
5 the ratio.

	Coaches % (No.)	Performance % (No.)	Players % (No.)	Proportion Ratio	Qualitative Inference
During the 2018/19 season, what league does your current senior/first team compete in?					
Premier League	18 (6)	35 (28)	25 (15)	0.5; 0.7; 1.4	Large; Large; Small
Championship	38 (13)	18 (14)	16 (10)	2.1; 2.4; 1.1	Large; Large; Trivial
League 1	15 (5)	11 (9)	27 (17)	1.4; 0.6; 0.4	Small; Moderate; Large
League 2	9 (3)	11 (9)	24 (15)	0.8; 0.4; 0.5	Small; Large; Large
Other (e.g. National League)	21 (8)	24 (19)	8 (5)	0.9; 2.6; 3.0	Small; Large; Large
Which age group are you primarily responsible for?					
First Team	53 (18)	53 (41)	47 (29)	1.0; 1.1; 1.1	Trivial; Trivial; Trivial
Professional Development Phase	26 (9)	28 (22)	53 (33)	0.9; 0.5; 0.5	Small; Large; Large
Youth Development Phase	18 (6)	9 (7)		2.0	Large
Foundation Phase	0 (0)	0 (0)		0.0	Trivial
More than 1 age group	3 (1)	9 (7)		0.3	Very Large
Other	0 (0)	0 (0)		0.0	Trivial
How many years' experience do you have in your current/similar role in professional soccer?					
0-3 years	3 (1)	44 (34)		0.1	Extremely Large
4-6 years	0 (0)	21 (16)		0.0	Extremely Large
7-9 years	26 (9)	22 (17)		1.2	Small
10-12 years	26 (9)	9 (7)		1.2	Small
13-15 years	18 (6)	1 (1)		18	Extremely Large
More than 15 years	26 (9)	4 (3)		6.5	Large

Table 2. Mean (± SD) coach, performance staff and players responses to the Likert scale importance of sport science training data to influence practice questions, along with the mean difference, p values and 95% confidence intervals.

	Coaches (Mean ± SD)	Performance (Mean ± SD)	Player (Mean ± SD)	Clear 1-Point Diff on Likert Scale (Mean Diff; p Value; 95% CI)
How important do you feel sport science information, such as that collected from GPS tracking devices, is in guiding:				
Your own practice?	Somewhat important (3.3 ± 0.8)	Very important (4.0 ± 0.8)		No (-0.67; p = 0.00; -1.0 to -0.34)
Your coach's practice?		Somewhat important (3.4 ± 0.9)	Very important (3.6 ± 0.8)	No (0.22; p = 0.14; -0.07 to 0.53)
How important is the sport science data in contributing to the following:				
Planning training	Somewhat important (3.5 ± 0.8)	Very important (3.7 ± 0.9)	Very important (3.6 ± 0.9)	No (-0.21; p = 0.53; 0.66 to 0.24); No (-0.11; p = 0.83; -0.58 to 0.35); No (0.09; p = 0.84; -0.24 to 0.66)
Coach team selection	Not important (2.1 ± 1.0)	Not important (2.4 ± 1.0)	Somewhat important (2.7 ± 1.0)	No (-0.3; p = 0.34; -0.79 to 0.2); No (-0.58; p = 0.22; -1.09 to -0.07); No (-0.29; p = 0.25; -0.71 to 0.14)
Winning matches	Not important (1.8 ± 0.9)	Somewhat important (2.6 ± 1.0)	Somewhat important (3.0 ± 1.0)	No (-0.88; p < 0.01; -1.38 to -0.39); Yes (-1.29; p < 0.00; -1.8 to -0.78); No (-0.41; p = 0.07; -0.83 to 0.02)
Player retention	Not important (1.9 ± 1.0)	Somewhat important (2.6 ± 1.2)	Not important (2.4 ± 1.0)	Yes (-0.71; p < 0.01; -1.24 to -0.17); No (-0.43; P = 0.15; -0.99 to 0.12); No (0.27; P = 0.34; 0.17 to 1.24)
Player fitness	Very important (4.0 ± 0.8)	Very important (4.0 ± 0.9)	Very important (3.9 ± 0.9)	No (0.06; p = 0.94; -0.37 to 0.49); No (0.08; p = 0.90; -0.36 to 0.52); No (0.02; p = 0.99; -0.34 to 0.39)
Injury prevention	Very important (3.9 ± 0.7)	Very important (3.8 ± 0.7)	Very important (4.0 ± 1.0)	No (0.74; p = 0.93; -0.4 to 0.55); No (-0.05; p = 0.97; -0,54 to 0.44); No (-0.13; p = 0.74; -0.53 to 0.28)
Assessment of effort	Very important (3.7 ± 0.8)	Very important (3.6 ± 0.9)	Very important (3.7 ± 1.0)	No (0.15; p = 0.73; -0.31 to 0.61); No (-0.01; p = 0.99; -0.48 to 0.47); No (-0.16; p = 0.62; -0.55 to 0.24)

1 **Table 3**. Proportion of performance staff and coach's response to use of training data to evaluation and reflection, along with ratio of proportion (PS: C) and
2 qualitive inference for the ratio. Also included mean (± SD) performance staff and coach responses to the Likert scale value of training data to evaluation and
3 reflection, along with the mean difference, *p* value and 95% confidence interval (CI) for the difference.
4

	Performance %	Coaches %	Proportion Ratio	Qualitative Inference
How many times per week will you typically reflect and evaluate on your training sessions:				
With your coaching staff?				
None	11	0	0.0	Extremely Large
1	24	0	0.0	Extremely Large
2 to 3	31	18	0.6	Large
4 to 5	16	38	2.4	Large
More than 5	19	44	2.3	Large
With your sport science department?				
None	4	9	2.3	Large
1	9	38	4.2	Very Large
2 to 3	30	47	1.6	Moderate
4 to 5	20	6	0.3	Very Large
More than 5	36	0	0.0	Extremely Large
When does this typically take place?				
No specific timing structure (i.e. informal conversations)	55	74	1.4	Small
Immediately following training	20	50	2.5	Large
Later in the day	28	18	0.6	Moderate
In the morning before training	59	82	1.4	Small
Before a match	4	12	3.0	Large
After a match	35	15	0.4	Large
After concerning events (e.g. injury/poor performance)	49	47	1.0	Trivial
Other	7	9	1.3	Small
	Performance (Mean ± SD)	**Coaches (Mean ± SD)**	**Clear 1-Point Diff on Likert Scale (Mean Diff; *p* Value; 95% CI)**	
How do you value sports science data in this process? For example, do you require to see the information prior to these discussions	Somewhat valuable (3.4 ± 0.8)	Very valuable (3.9 ± 0.8)	No (-0.5; P = 0.002; -0.8 to -0.2)	

and use it as a focal point for which you can evaluate and make decisions on going forward?

	Performance %	Coaches %	Proportion Ratio	Qualitative Inference
Work rate/intensity	79	74	0.9	Trivial
High-intensity actions (i.e. high-speed running)	94	82	0.9	Trivial
Analysis of individual drills	51	29	0.6	Moderate
Comparing physical outputs to what players do in a match	64	59	0.9	Trivial
Individual player workload	77	47	0.6	Moderate
Average workload by whole squad or playing position	54	21	0.4	Large
Fatigue response, such as how tired a player is due to a session	29	18	0.6	Moderate
Other	6	6	1.0	Trivial

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1 **Table 4**. Mean (± SD) performance staff and coach responses to the Likert scale barriers to feedback questions along with the mean difference, *p* value and
2 95% confidence interval (CI) for the difference.
3

	Performance (Mean ± SD)	Coach (Mean ± SD)	Clear 1-Point Diff on Likert Scale (Mean Diff; *p* Value; 95% CI)
What are the barriers in reducing your coach's use of training data to inform their practice?			
Lack of understanding	Neither agree nor disagree (3.4 ± 1.0)	Neither agree nor disagree (3.0 ± 1.2)	No (-0.6; *p* = 0.01; -1.1 to -0.2)
Information delivered in unsuitable format	Neither agree nor disagree (2.9 ± 1.2)	Neither agree nor disagree (3.0 ± 1.1)	No (-0.2; *p* = 0.39; -0.7 to 0.3)
Too much information	Neither agree nor disagree (3.1 ± 1.1)	Agree (4.1 ± 1.0)	No (0.8; *p* = 0.01; 0.3 to 1.3)
Poor communication	Neither agree nor disagree (3.1 ± 1.2)	Agree (3.7 ± 0.9)	No (0.6; *p* = 0.01; 0.1 to 1)
Lack of a common goal	Agree (3.6 ± 1.0)	Agree (3.6 ± 0.9)	No (0.1; *p* = 0.82; -0.4 to 0.5)
Takes too long	Disagree (2.5 ± 1.0)	Disagree (1.9 ± 0.9)	No (-0.6; *p* = 0.01; -1 to -0.2)
Impact on players	Neither agree nor disagree (2.6 ± 1.1)	Disagree (2.3 ± 1.0)	No (-0.4; *p* = 0.12; -0.8 to 0.1)
Not seeing benefits or seeing it 'work'	Neither agree nor disagree 2.8 ± 1.1)	Neither agree nor disagree (3.3 ± 0.9)	No (0.5; *p* = 0.03; 0 to 0.9)

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1 **Table 5**. Mean player response to the multiple-choice information feedback, along with mean (± SD) player response to the Likert scale on data on
2 presentation of data.
3

	Player %
After training, what information would you like to see?	
Total distance	89
High-speed running and sprint distances	87
Heart rate information (i.e. time spent in 'red zone')	40
Accelerations and decelerations	31
Maximum speed reached	73
Other	4
	Player (Mean ± SD)
How likely are you to look at your training data if it was presented to you by:	
Pinned up in the changing room	Likely (3.8 ± 0.5)
Pinned up in the gym	Neutral (3.2 ± 1.2)
Sent to your phone	Likely (4.3 ± 0.8)
Delivered in meetings	Neutral (3.4 ± 0.9)
Having seen your data after a training session, how likely is it that you will change your effort levels in the next day's training?	Likely (3.7 ± 1.0)
If you are able to see your data live in a training session, how likely is it that you will change your effort levels during the session?	Likely (3.9 ± 1.0)

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1 **Table 6**. Survey questions and possible responses for Coaches.
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Question	Type of Question	Possible Responses
What is your current primary role?	Multiple Choice	• Manager • Assistant Manager • Coach • Assistant Coach • Other
Which league does your current senior/first team compete in?	Multiple Choice	• Premier League • Championship • League 1 • League 2 • Other (e.g. national league)
Which age group are you primarily responsible for?	Multiple Choice	• First Team • PDP • YDP • FP • More than 1 age group • Other
How many years coaching experience do you have in professional football?	Multiple Choice	• 0-3 years • 4-6 years • 7-9 years • 10-12 years • 13-15 years • More than 15 years
How important do you feel sport science training information, such as that collected from GPS tracking devices, is in guiding your coaching practice? For example, do you use this information to make decisions on the contents of your training sessions or to make decisions on the work required for certain players, etc.	Likert Scale	1. Not important at all 2. Somewhat important 3. Important 4. Very important 5. Extremely important
How many times per week will you typically reflect and evaluate on your training sessions: a) On your own or with coaching staff?	Multiple Choice	• None • 1 • 2-3

b) With the sport science department?		• 3-4 • More than 5
When does this typically take place?	Multiple Choice	• No specific timing structure – informal conversations with staff • Immediately following training • Later in the day • In the morning before training • Before a match • After a match • After concerning events such as player injury or poor performance • Other
How do you value sports science data in this process? For example, do you require to see the information prior to these discussions and use it as a focal point for which you can evaluate and make decisions on going forward?	Likert Scale	1. Not valuable at all 2. Somewhat valuable 3. Valuable 4. Very valuable 5. Extremely valuable
From a physical perspective, which aspects of training information would you use to reflect/evaluate on your sessions?	Multiple Choice	• Work rate/intensity • High-intensity actions (i.e. high speed running distance) • Analysis of individual drills • Comparing physical outputs to what players do in a match • Individual player workload • Average workload either by the whole squad or by playing position • Fatigue response such as how tired a player is due to a session • Other
How important are the following in contributing to designing your training sessions? a) Previous experience as a player b) Own coaching experience and intuition c) Coaching courses and clinics	Likert Scale	1. Not important at all 2. Somewhat important 3. Important 4. Very important 5. Extremely important

d) Watching other coaches e) Advice from science and medical department f) Sport science training data g) Online, such as videos and blogs		
How important is the sport science data in contributing to the following? a) Planning training b) Team selection c) Winning matches d) Player retention e) Player fitness f) Injury Prevention g) Assessment of effort	Likert Scale	1. Not important at all 2. Somewhat important 3. Important 4. Very important 5. Extremely important
How strongly do you consider each of the following issues are in reducing your use of sport science data to inform your coaching practice? a) Lack of understanding b) Information delivered in an unsuitable format c) Too much information d) Poor communication from sport science team e) Lack of a common goal in the use of the training data f) Takes too long g) Impact on players h) Not being able to see its benefits or seeing it 'work'	Likert Scale	1. Not strong at all 2. Somewhat strongly 3. Strongly 4. Very strongly 5. Extremely strongly
Do you believe that players are mostly affected in a positive or negative manner by seeing their training and match data?	Multiple Choice	• Positive • Negative • Both
Do you think that players may alter their behaviour in training due to this? For example, if a player is shown to have covered much less distance than players in a similar position, will they increase their output in the next training session.	Multiple Choice	• Yes • No

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1   **Table 7**. Survey questions and possible responses for Performance Staff.
2

Question	Type of Question	Possible Responses
What is your current primary role?	Multiple Choice	• Sport scientist • Strength and conditioning coach • Medical staff (Physio, Doctor) • Performance analyst • Other
Which league does your current senior/first team compete in?	Multiple Choice	• Premier League • Championship • League 1 • League 2 • Other (e.g. national league)
Which age group are you primarily responsible for?	Multiple Choice	• First Team • PDP • YDP • FP • More than 1 age group • Other
How many years experience do you have in professional football?	Multiple Choice	• 0-3 years • 4-6 years • 7-9 years • 10-12 years • 13-15 years • More than 15 years
How important do you feel sport science information, such as that collected from GPS tracking devices, is in guiding: a) Your practice? b) Your coaches practice?	Likert Scale	1. Not important at all 2. Somewhat important 3. Important 4. Very important 5. Extremely important
How many times per week will you typically reflect and evaluate the coach's training sessions: a) With the coaching staff?	Multiple Choice	• None • 1 • 2-3

b) With the sport science/medical department?		• 3-4 • More than 5
When does this typically take place?	Multiple Choice	• No specific timing structure – informal conversations with staff • Immediately following training • Later in the day • In the morning before training • Before a match • After a match • After concerning events such as player injury or poor performance • Other
How do you value sports science data in this process? For example, do you require to see the information prior to these discussions and use it as a focal point for which you can evaluate and make decisions on going forward?	Likert Scale	1. Not valuable at all 2. Somewhat valuable 3. Valuable 4. Very valuable 5. Extremely valuable
From a physical perspective, which aspects of training information would you typically report back to coaches to support their evaluation of their sessions?	Multiple Choices	• Work rate/intensity • High-intensity actions (i.e. high-speed running distance) • Analysis of individual drills • Comparing physical outputs to what players do in a match • Individual player workload • Average workload either by the whole squad or by playing position • Fatigue response such as how tired a player is due to a session • Other
How important do you believe your coach values the following as sources of information for designing training practices? a) Previous experience as a player b) Own coaching experience and intuition c) Coaching courses and clinics	Likert Scale	1. Not important at all 2. Somewhat important 3. Important 4. Very important 5. Extremely important

d) Watching other coaches e) Advice from science and medical department f) Sport science training data g) Online, such as videos and blogs		
How important is the sport science information in contributing to the following? a) Planning training b) Team selection c) Winning matches d) Player retention e) Player fitness f) Injury Prevention g) Assessment of effort	Likert Scale	1. Not important at all 2. Somewhat important 3. Important 4. Very important 5. Extremely important
How strongly do you consider each of the following issues are in reducing your coach's use of sport science data to inform their coaching practice? a) Lack of understanding b) Information delivered in an unsuitable format c) Too much information d) Poor communication from sport science team e) Lack of a common goal in the use of the training data f) Takes too long g) Impact on players h) Not being able to see its benefits or seeing it 'work'	Likert Scale	1. Not strong at all 2. Somewhat strongly 3. Strongly 4. Very strongly 5. Extremely strongly
Do you believe that players are mostly affected in a positive or negative manner by seeing their training and match data?	Multiple Choice	• Positive • Negative • Both
Do you think that players may alter their behaviour in training due to this? For example, if a player is shown to have covered much less distance than players in a similar position, will they increase their output in the next training session.	Multiple Choice	• Yes • No

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1 **Table 8**. Survey questions and possible responses for Players.
2

Question	Type of Question	Possible Responses
Which league does your current senior/first team compete in?	Multiple Choice	• Premier League • Championship • League 1 • League 2 • Other (e.g. national league)
Which age group do you primarily play for?	Multiple Choice	• First Team • Under 23 • Under 18 • Other
How many years have you been playing professional football?	Multiple Choice	• Less than 5 years • 6-10 years • More than 10 years
How important do you feel sport science information, such as that collected from GPS tracking devices, is in guiding your coaches' practice?	Likert Scale	1. Not important at all 2. Somewhat important 3. Important 4. Very important 5. Extremely important
Typically, data such as distances in different speed zones is collected from yourself during training using GPS units. How important do you think this data is to each of the following? a) Planning training b) Team selection c) Winning matches d) Player retention e) Player fitness f) Injury Prevention g) Assessment of effort	Likert Scale	1. Not important at all 2. Somewhat important 3. Important 4. Very important 5. Extremely important
After training, what GPS information would you like to see?	Multiple Choice	• Total distance • High-speed running and sprint distances • Heart rate information • Accelerations and decelerations

		• Your maximum speed reached
How likely are you to look at your training data if it was delivered to you in each of the following ways? a) A comparison of what you achieved on the day against your average for that day previously i.e. your output on the day before a match against your average for that day previously b) A comparison against players in your playing position c) A comparison against all players in your squad d) Your output in individual drills e) Your output compared to a typical 90 minute match	Likert Scale	1. Not likely at all 2. Somewhat likely 3. Likely 4. Very likely 5. Extremely likely
Having seen your data after a training session, how likely is it that you will change your effort levels in the next days training? For example, if you are shown to have covered much less distance than players in a similar position, will this motivate you in future training sessions? a) Pinned up in the changing room b) Pinned up in the gym c) Sent to your phone d) Delivered in meetings e) Other	Likert Scale	1. Not likely at all 2. Somewhat likely 3. Likely 4. Very likely 5. Extremely likely

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