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AN EXPLORATORY STUDY OF ELITE NETBALL COACHES' ENGAGEMENT WITH IN-GAME STATISTICS DURING COMPETITION

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INTRODUCTION

Netball is a dynamic, fast-paced team sport where coaches and players are required to make decisions quickly during a match. Live video replays are possible via modern streaming technologies; however, due to the continuous and high-speed nature of the game, coaches have limited time to look at a video replay device. Statistical data are utilised by coaches to provide insights into the current state of the game (Nicholls et al., 2018) and can be used to support decision making. Public domain websites (Champion Data, 2020) broadcast live statistical information about the state of netball matches in many international, elite club, national, and school competitions. The live information that these websites provide includes scoring, team statistics, individual player performance, opposition player performance, team performance comparisons, shooting performance, top five player rankings, score sequences, and player interchange. These categories align with many of the tactical themes used by coaches as observed in research investigating coach discussions (Croft et al., 2020).

Recent research has looked at the use of statistical information by coaches in providing feedback to athletes and players (Nicholls et al., 2018; Middlemas et al., 2017). However, there is a need for further research examining coaches' interactions with such information during a match. This is important for performance analysts to understand what information could support coaches by streamlining observation and feedback aspects of the coaching process (Drust, 2010; Nicholls et al., 2018; Williams & Kendall, 2007).

Croft et al. (2020) explored the spoken behaviours of netball coaches, identifying themes around tactics and strategies using an inductive content analysis. Subsequent work has looked to align and contextualise information within these themes (Croft & Spencer, 2021). When statistical information, such as team scoring success or individual player performance indicators, is presented to coaches, it then becomes necessary to observe their interactions with it (Edwards, 2017) to help understand its value and therefore validity. Despite existing research on coach behaviour in various sports, netball is not well understood and thus requires further investigation. Due to this, netball lends itself to descriptive and explorative research approaches (Cushion et al., 2012) to establish a basis for future research in coach behaviour.

Observational field research is an effective tool for understanding behaviour (Gray et al., 2007) as it can provide complex insights into what participants do and require. Consequently, observation research has strong ecological validity and is a good method for understanding coach behaviour and subsequently what information may be important to them during a sports match. Previous research (Cushion et al., 2012) has developed tools for instrumented coach observation. Computers and software such as Hudl-Sportcode, (https://www.hudl.com/products/sportscode) have enabled complex analysis of behaviours and, it could be argued, have better reliability

and validity than pencil and paper notational analysis. Information technologies, such as video coded data and sensor devices, have been described as both a source of knowledge and a resource for coaches; however, the role of these technologies in understanding of coach learning is critically unexplored (Cushion & Townsend, 2018). Observations of coaches' interactions with information technology have the potential to add to the evidence base and improve our understanding of the role it can play. Aligning these behaviours with the spoken tactical themes identified in previous research (Croft et al., 2020; Zetou et al., 2011) will give insights into whether a coach's spoken communications are closely aligned with their decision making.

The objectives of this study were to: 1) measure the types, frequencies, and durations of statistics viewed by netball coaches during matches; 2) describe the movement between different types and complexities of information by coaches; and 3) to observe the amount of congruence between their communications, identified in previous research (Croft et al., 2020), and statistical information from the current research. The purpose of this study was to describe through observation, and explore, how elite netball coaches use statistics during netball games so that performance analysts can better design what information is presented to them in a live setting.

METHODOLOGY

Design

An observational field research approach was adopted with a post-positivism ontology to frame this research, as it acknowledges that knowledge is a combination of theory and practice, where different methods can be utilised (Henderson, 2011; Ryan, 2006). An inductive data analysis approach (Elo & Kyngäs, 2008; Neuendorf, 2002) where open coding, creation of categories, and abstraction was implemented. This approach aligns this study with that which Croft, Spencer, and Robertson (2020) conducted on the same participant group, allowing for comparison of results.

Participants

Six elite netball coaches, who currently coach in either the National Netball League (NNL) or ANZ Premiership (ANZP) were recruited voluntarily via email. The inclusion criterion of coaching at NNL or ANZP level was set as this group had access to either a performance analyst or performance statistics, and therefore experience with using this information. Participants approached the researchers to participate in the study, having been provided information about it via their high-performance manager. Their involvement was kept confidential from their high-performance manager and all others, except the lead researcher. Ethical approval for the study was granted by the Auckland University of Technology Ethics Committee (AUTEC) (Ethics Application 21/33).

Equipment

Each coach was provided with an Apple iPad device, which was connected to the internet via a local high speed Wi-Fi network. The iPad was configured to show a live statistics website (https://mc.championdata.com/anz_premiership/index.html) on the right two-thirds of the screen and the device's internal camera on the left one-third of the screen. The camera's perspective was that of the coach, enabling identification of frequency and duration of screen viewing. The website had several pages of statistics, which align with those identified as important in previous research (Croft et al., 2020). A screen recording was taken of the iPad, identifying all interactions with the device as well as the participant's visual gaze. For all participants a stable connection to the internet was achieved and there were no connection issues identified.

Hudl-Sportscode notational analysis software was used to code the website pages, and therefore the category of statistic the coaches looked at during a netball match and the duration in seconds. Table 1 shows the statistics' screen name, the information displayed, and an overall description for the page.

Statistics screen name	Information displayed	Description
Scoring	Possession source to goal frequency and success Score worm graphic Last score and misses Lead and scoring streak	Statistics that provide information about trends and current state of scoring events.
Team Stats	Time in possession Gains, intercept, deflection resulting in a gain Penalty – Contact and obstruction Possession changes General play turnover Shooting zones and success	Combine actions of the team that are either attacking or defensive and reflect losing or maintaining possession of the ball.
Player Grid	Player time in the game Frequency of action variables in the match, including: Goals, goal attempts, goal shoot percentage, goal assist, feed, feed with attempt, gains, intercept, intercept pass thrown, deflection gain, deflection no gain, rebound, centre pass received, pick up, penalty contact, penalty obstruction, general play turnover, bad pass, bad hands, offside, and centre pass break	Individual actions for own team that are either positive, scoring, or possession gaining, or errors that lead to losses of possession of penalties.
Opposition Player Grid	Same as player grid but for opposition players	Individual actions for opposition team that are either positive, scoring, or possession gaining, or errors that lead to losses of possession of penalties.
Both Teams Player Grids	Goal, goal attempts, goal shoot percentage, feed, rebound, centre pass received, penalty, general play turnover	An abbreviated player grid allowing for comparison of both teams' individual players.
Goal Shooter	Current player goal shoots, attempts and successful percentage	A view of the shooting performances of the four players on court at the time of viewing, for both teams.
Top 5	Individual player counts for: Feed, goal assists, centre pass received, penalty, general play turnover	A view showing the five players on court for highest counts for five individual actions.
Score Flow	Shooting attempt outcome, ordered by game time, and current score	A temporal list of scoring and non-scoring attempts for both teams.
I/Change	Individual player substitutions, positions, and time	A temporal record of player substitutions with position and game time these are made.

Table 1. Content of statistics screens available to coaches for navigation during their live netball match.

Procedures

As the coaches watched the live NNL or ANZP feed of their team's netball match, they sat with the iPad detailed in the previous section on their lap. The iPad displayed the live match statistics and the participants were instructed to look at the screen when information about the game was of interest to them. Before the match began the iPad's' 'screen record' feature was activated so that all information present on screen was recorded into an mp4 format video file. This ensured that the following information was captured: the website subpages selected, zooming on the device, the information observed, and (via the web camera screen display) visual gaze frequency and length.

Data analysis

Once the video data was captured the files were loaded individually into Hudl-Sportcode, where each of the coach's gazes were coded for length and group of statistics viewed. This was calculated by coding the first video frame the participant looked at on the iPad until the last frame before they looked away. The length of the coded instance was recorded in Hudl-Sportcode and measured by using a "COUNT INSTANCE LENGTH" script. Due to a video frame sample rate of 30fps, an accuracy of 0.03s was achieved. This enabled data to be recorded for the frequency, type, and duration of statistics viewed. These measures also enabled analysis of the order in which each coach viewed the statistics and their movement between the statistical categories. Inter-coder reliability was checked by another performance analyst coding a sample of the video footage while intra-coder reliability was confirmed by the primary researcher repeat coding a sample of video footage also. As the sample size was limited to six participants, observed during one match each, data analysis could not be conducted with a range of statistical tests. Rather, descriptive analysis of visualisation of the measures collected was deemed more appropriate for this dataset. Analysis of the data was focused on two areas: the most common categories of statistics viewed (duration and frequency), and a comparison between participants. This was achieved by calculating means ± SD, but also through visualisations due to the small sample size and descriptive nature of the research.

RESULTS

As seen in Table 2, coaches spent the most time viewing "Team Stats" information, in both total duration and frequency (167.8s and 30.5 times per match respectively). However, the time per view was one of the shortest (5.5s) durations of all the categories. This was followed by the "Scoring" category (133.3s per match) and "Both Teams" (127.8s per match). However, Scoring was looked at less frequently (16 times per match) but for longer (8.4s versus 6.6s per view respectively). Additionally, the "Player Grid" and "Opposition Player Grid" screens were viewed for the longest duration (11s and 10.6s per view respectively); however, with a frequency of 10.8 and 3 times per match, per coach. "Opposition Player Grid," "Goal Shooter," "Top 5," "Score Flow," and "I/Change" were viewed the least (31.9s, 10.8s, 33.0s, 19.0s, and 3.9s per match respectively) with comparatively low frequencies. Overall, coaches viewed the statistics screen for 7.8s duration, with a mean of 71.9 views per game and a total viewing time of 646.7 s per game. This equates to approximately 11 percent of the total game duration.

Types, frequency, and duration of viewing statistical information

	Total viewing time (s)		Frequency of views		Time per view (s)
	mean (±SD)	total	mean (±SD)	total	
Scoring	133.3±144.1	799.9	16.0±12.3	96	8.3
Team Stats	167.8±108.5	1007	30.5±26.8	183	5.5
Player Grid	119.2±50.2	715	10.8±3.3	65	11.0
Opposition Player Grid	31.9±23.9	191.6	3±1.6	18	10.6
Both Teams	127.8±60.6	766.6	19.5±25.1	117	6.6
Goal Shooter	10.8±12.0	64.8	1.7±1.5	10	6.5
Top 5	33.0±48.7	198.1	3.3±4.5	20	9.9
Score Flow	19.0±16.2	114	4.5±5.6	27	4.2
I/Change (interchange)	3.9±8.0	23.3	0.5±0.8	3	6.6
Average	71.9s		10.0		7.8s
Total	646.7s		89.8		

Table 2. Summary of the statistical information viewed, for frequency and duration, by coaches during live netball matches.

Frequency of views

The results show that coaches most frequently viewed the Team Stats screen (Table 2). This screen (Figure 1) presents measures of possession, gains, and losses, in the statistics: Time in Possession," Gains," 'Intercept," "Deflection Resulting in a Gain," "Penalty – Contact and Obstruction," "Possession Changes," and "General Play Turnover." It also displays shooting zones for each team on both sides. It was observed that this centre Team Stats block was utilised (zoomed into) by coaches for the most time during a match.

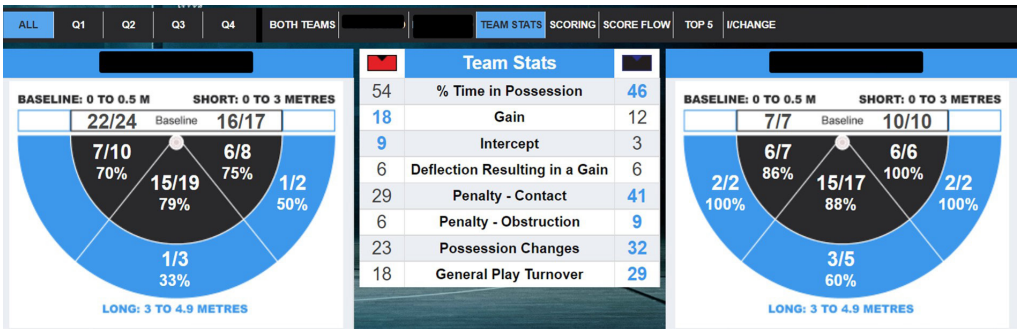

Figure 1. Screen capture of the Team Stats category within website.

The second most frequently viewed category was "Scoring" (Table 2). The Scoring category shared similarities to the Team Stats in that it displayed team outcome information related to success of the teams in scoring goals from "Centre Passes," "Gains," and "Unforced Turnovers." This category focused on measures more directly related to goal scoring than Team Stats, and provided a visualisation of points difference between teams across the match time. The third category most engaged with by coaches included the "Player Grid" and "Both Teams" grids. Both displayed similar information regarding the individual performances of players in the coach's team, and then a comparison of individual players for both teams. If it is considered that these categories are different representations of the same group of individual statistics, the total time coaches viewed these is larger (139.7s and 116.2s per game) than the single largest category (190.1s per game) of Team Stats.

Total viewing time

Figures 2 and 3 demonstrate that in most categories of statistics, coaches viewed the three individual player categories in a similar manner for both total viewing time and frequency of views respectively. These were Player Grid (119.2±50.2s and 10.8±3.3, Table 2), Opposition Player Grid (31.9±23.9s and 3±1.6, Table 2), and Both Teams for its total viewing time, but not frequency of views (127.8±60.6s and 19.5±25.1, Table 2) where there was large variation. In all three categories, at least five of the six coaches demonstrated similar behaviours. For the team-based statistical categories of Scoring and Team Stats, there was very high engagement in both duration and frequency for two coaches; however, many other coaches had low or no engagement. This is also reflected as a large standard deviation, relative to the mean, for Team Stats (133.3±144.1s and 30.5±26.8) for total viewing time and frequency of views respectively. The Scoring category showed large standard deviations also (133.3±144.1s, 16.0±12.3).

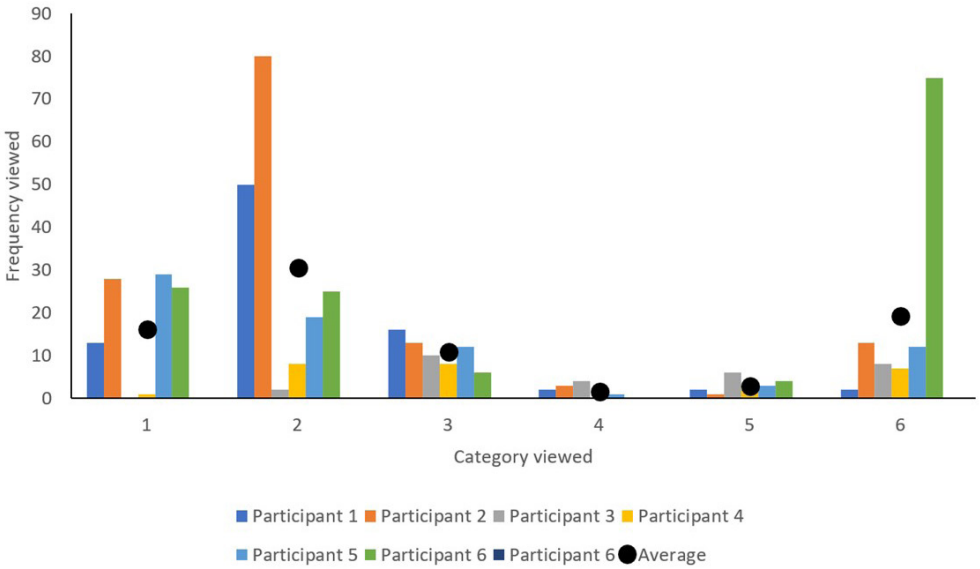

Figure 2. Individual variation, in frequency, between participants' engagement with categories of statistics.

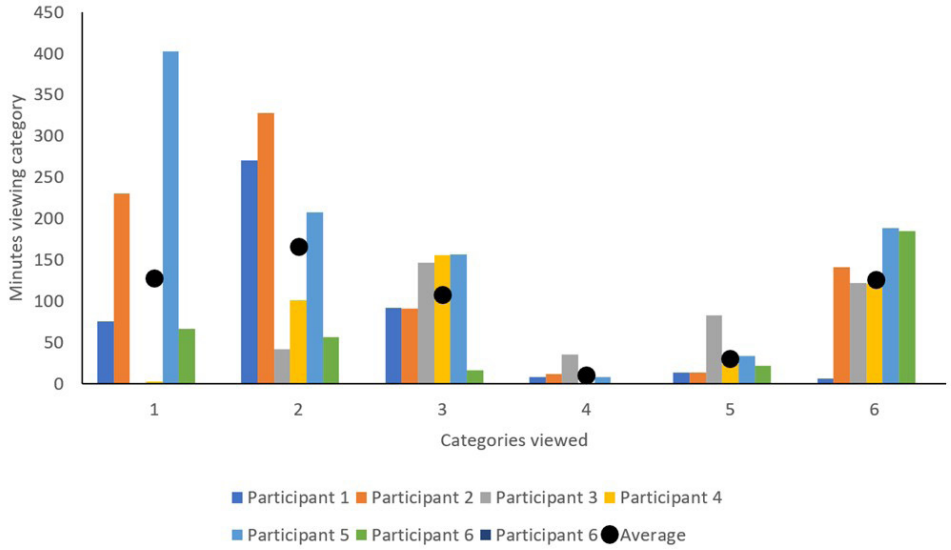

Figure 3. Individual variation, in duration, between participants' engagement with categories of statistics.

Patterns of movement between categories

Not only was the frequency of engagement observed, but also the patterns of movement between categories or screens. Many coaches tended to stay on a screen such as Team Stats or Scoring, glancing at it frequently, then moving to another category before returning to this screen (Table 3). Table 3 shows that the most common sequences of categories that all coaches moved between were from Scoring to Team Stats, Player Grid to Team Stats and from Team Stats back to Player Grid.

Start screen		End screen	Frequency
Scoring	-->	Team Stats	26
Player Grid	-->	Team Stats	24
Team Stats	-->	Player Grid	23
Team Stats	-->	Scoring	20
Both Teams	-->	Team Stats	20
Scoring	-->	Player Grid	17
Team Stats	-->	Both Teams	15
Player Grid	-->	Scoring	15
Player Grid	-->	Both Teams	10
Both Teams	-->	Player Grid	7

Table 3. Frequency of movements between statistical categories, for all coaches, during live netball matches.

To better visualise these movements, a network graph (Figure 4) displays the categories with arrows and font size weighted for frequency and movement between categories, in the direction the coach moved. All arrows pointing towards Team Stats are heavily weighted, implying that a return to this category after being in another was the most common movement. Movement away from this category was also high, which could be due to it being the most common that coaches looked at. Font size was set at 10 percent of the category frequency displayed in Table 3, while arrow thickness (point size) was set at 25 percent of the frequency of the combination displayed in Table 3.

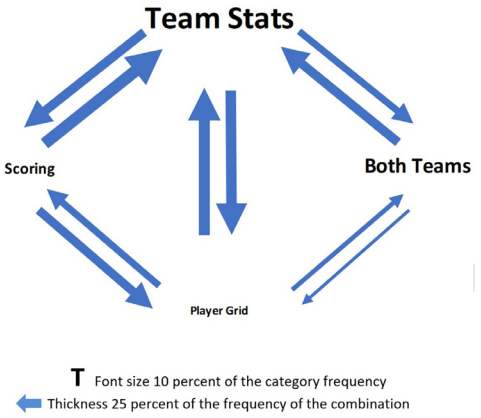

Figure 4. Network graph of the coach movements between statistical categories, weighted for font size and arrow thickness to scale.

Congruence with spoken communication identified in previous research

When the themes of spoken behaviour (Croft et al., 2020) are aligned with statistical categories of this research, it can be seen (Table 4) that the individual player statistics Player Grid (37 percent) and Opposition Player Grid (39.3 percent) had strong alignment with the spoken themes from Croft et al. (2020). Themes also aligned well with the Both Teams Player Grid (26.1 percent) and Scoring (24.9 percent) categories. The Goal Shooter (18.4 percent), Top 5 (18.4 percent), and Score Flow (17.7 percent) categories had weaker alignment with the spoken themes of coaches. These similarities demonstrate some congruency between the two behaviours.

Spoken behaviour	Statistics webpage categories	Alignment percentage of spoken themes	Description
Scoring Attacking actions Defending actions	Scoring	24.9	Statistics that provide information about trends and current state of scoring events.
Player positioning Team positioning Attacking actions Defending actions Errors Attack strategy Defensive strategy	Team Stats	46.6	Combine actions of the team that are either attacking or defensive and reflect losing or maintaining possession of the ball.
Centre pass Gains/ Losses Attacking actions Defending actions Errors Attack strategy Defensive strategy	Player Grid	37	Individual actions for own team that are either positive, scoring, or possession gaining, or errors that lead to losses of possession of penalties.
Opposition actions Centre pass Attacking actions Defending actions Gains/Losses Errors Attack strategy Defensive strategy	Opposition Player Grid	39.3	Individual actions for opposition team that are either positive, scoring, or possession gaining, or errors that lead to losses of possession of penalties.
Opposition actions Centre pass Gains/ Losses Attacking actions Errors	Both Teams Player Grids	26.1	An abbreviated player grid allowing for comparison of both teams' individual players.

Errors Attacking actions	Goal Shooter	18.4	A view of the shooting performances of the four players on court at the time of viewing, for both teams.
Attacking actions Centre pass Errors	Top 5	18.4	A view showing the five players on court for highest counts for five individual actions.
Attacking actions	Score Flow	17.7	A temporal list of scoring and non-scoring attempts for both teams.

Table 3. A comparison of the spoken themes identified by Croft et al. (2020) and the coach engagement with statistical categories.

DISCUSSION

Types, frequency, and duration of viewing statistical information

The purpose of this research was to observe coach interactions with statistical information during live netball matches, providing insights for performance analysts who develop live analysis tools. The first objective was to measure, using computerised analysis (Cushion et al., 2012), the frequencies and durations of the different types of information viewed by these coaches. Coaches engaged more consistently with individual player statistics (Player Grid, Opposition Player Grid, and Both Teams), which make up the Team Stats and Scoring. This could be explained by the complexity of the statistical information, with the Team Stats and Scoring categories being constructed from the combined actions of players and possession outcomes; for example, the "Team Stats – Intercepts" is the sum of all individual player Intercepts. Team Stats had the shortest duration per view; however, there were many such views, implying that the coach's behaviour was to glance quickly and often, updating themselves with the state of this information. Nash and Collins (2006) describe coaches as avoiding the use of too many cognitive resources for unfamiliar situations and tending to rely on prior knowledge from a similar situation. This could explain why we see coaches favour more familiar or simplistic statistics during games, as there are already high cognitive demands on them.

The team-based categories of Scoring and Team Stats had different levels of engagement between coaches. Some had very high engagement in both duration and frequency, while others had low or no engagement. Anecdotally, between the six coaches there were differing levels of understanding of these types of statistic and this could be reflected in different perceptions of their value.

Patterns of movement between categories

The second objective of this research was to analyse the coaches' movements between categories of statistics to provide further insights into coaches' use of this information. The most common movements were from Team Stats to other categories, often returning back to Team Stats. One of the most frequent patterns was to

move from Team Stats, a group of combined team statistics, to a category that represented individual player performance; in other words, the Player Grid. The Team Stats are a combination of individual player actions, or events, and this movement may indicate that coaches navigate layers of statistics to 'dig down' for causes of the measures. This finding aligns with many of the principles of dashboard design (Juice, 2009) and with the concept of relational organisation. Dashboard design will often allow the user to expand information, revealing more detailed information about the high-level metrics. There are also research frameworks that implement this relational approach (Weed, 2009)

Congruence between coach discussions and statistical information viewed

The third objective of this research was to compare the results from objective one with the themes identified by Croft et al. (2020), to see if there was congruence between what coaches talked about and the statistics they viewed. It was found that 58.3 percent of these themes were represented in the categories viewed by the coaches in this study. Coincidentally, the largest category, Team Stats, was the most representative of the spoken themes with 46.6 percent similarity. This supports the concept that there is a relationship between spoken behaviour and engagement in statistics. This in turn confirms the assumption that spoken behaviours are indicative of information coaches require, aligning with the findings of Croft et al. (2020). Some categories, such as Scoring (24.9 percent), had weaker alignment with the spoken themes of coaches. This could represent that they view some statistics often (16 views per match, at 8.3s each) but do not discuss them because they are an outcome measure, not requiring interpretation of their meaning. The more complex categories, such as Scoring, are created from complex combinations of actions, positioning, errors, and strategy, as seen in Table 3, and could provoke more discussion to contextualise and interpret these events.

Limitations

As this study was set in high-performance netball the population for suitable participants was small. With time constraints and delays due to COVID-19 restrictions the researchers were only able to recruit six participants. This meant that statistical analysis of results was not undertaken, and a descriptive approach was necessary. The small sample size also meant that collecting demographic information about the participants would have risked their anonymity. Having such information would have been useful in the analysis and discussion of results as it could have brought context to some of the differences observed.

CONCLUSION

There were several findings and insights discovered in this study that can help a performance analyst understand a coach's engagement with match statistics in netball. These include the frequency of views and total viewing time for different categories of statistics. Insights were also discovered into coaches' movements between statistical category types. For some coaches, these movements were between complex and simple, and team and individual, statistics. There was also congruency between the statistical categories viewed and what coaches discussed, as detailed in previous research. The congruency was highest for complex team statistics which may require discussion to help interpret and contextualise. A performance analyst could utilise these findings to influence the design of information tools that are more aligned with the coaches' behaviours.

Video version

https://youtu.be/pGrtZoXDjiQ?si=0vZD-9cRQEF3NPlk

This link leads to a video that has been generated to explain this paper in an interesting and engaging way for practitioners.

Associate Professor **Hayden Croft** is the Head of College of Health at Otago Polytechnic. He has held roles in industry as a performance analyst for the Silver Ferns (currently), Otago Rugby, NZ Rugby and World Rugby as a consultant. By teaching and practicing as a performance analyst, he has been able to understand the challenges that face practitioners and our graduates moving into jobs. Through his work alongside some amazing coaches, he has observed different approaches to leadership. https://orcid.org/0000-0001-6848-3000

A Professor at AUT University, New Zealand, **Kirsten Spencer**'s research is at the forefront of sports performance analysis, with a strong focus on developing and applying modern sports analytics to drive meaningful change in athletic performance and decision-making. As an applied researcher, she has employed cutting-edge analytical methods that prioritize research designs capable of identifying causal relationships with high precision.

Professor **Sam Robertson** leads the Sports Performance and Business programme within the Institute for Health and Sport at Australia's Victoria University. He oversees a number of the university's sports knowledge exchange partnerships, including those with Western Bulldogs. Sam supervises co-appointed staff, PhD and Honours students, as well as implementing innovative performance strategies with these partners.

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