Running head: Influences on netball umpires' decision-making

Decision-making of English Netball Superleague Umpires: Contextual and Dispositional Influences

Adele M. Burnett[a*], Daniel T. Bishop[a], Kelly J. Ashford[b], A. Mark, Williams[c], Noel P. Kinrade[a].

[a]Division of Sport, Health and Exercise Sciences, Brunel University London, Uxbridge, UB8 3PH, UK, Adele.Burnett@brunel.ac.uk; Centre for Cognitive Neuroscience, Brunel University London, Uxbridge, UB8 3PH, UK, Noel.Kinrade@brunel.ac.uk, Daniel.Bishop@brunel.ac.uk; [b] Cardiff School of Sport, Cardiff Metropolitan University, Cardiff, CF23 6XD, UK, kashford@cardiffmet.ac.uk; [c]Department of Health, Kinesiology and Recreation, University of Utah, Salt Lake City, UT84112, USA, Mark.Williams@health.utah.edu.

[*]Corresponding author. Division of Sport, Health and Exercise Sciences, Department of Life Sciences, College of Health and Life Sciences, Brunel University London, Uxbridge, Middlesex, UB8 3PH. Email address: Adele.Burnett@brunel.ac.uk (A. M. Burnett).

Abstract

Objectives. The decisions made by officials have a direct bearing on the outcomes of competitive sport contests. In an exploratory study, we examine the interrelationships between the decisions made by elite netball umpires, the potential contextual and environmental influences (e.g., crowd size), and the umpires' dispositional tendencies – specifically, their propensity to deliberate and ruminate on their decisions.

Design/Method. Filmed footage from 60 England Netball Superleague matches was coded using performance analysis software. We measured the number of decisions made overall, and for home and away teams; league position; competition round; match quarter; and crowd size. Additionally, 10 umpires who officiated in the matches completed the Decision-Specific Reinvestment Scale (DSRS).

Results. Regression analyses predicted that as home teams' league position improved the number of decisions against away teams increased. A model comprising competition round and average league position of both teams predicted the number of decisions made in matches, but neither variable emerged as a significant predictor. The umpire analyses revealed that greater crowd size was associated with an increase in decisions against away teams. The Decision Rumination factor was strongly negatively related to the number of decisions in Quarters 1 and 3, this relationship was driven by fewer decisions against home teams by umpires who exhibited higher Rumination subscale scores.

Conclusions. These findings strengthen our understanding of contextual, environmental, and dispositional influences on umpires' decision-making behaviour. The tendency to ruminate upon decisions may explain the changes in decision behaviour in relation to the home team advantage effect.

Key Words: avoidance; reinvestment; rumination; referee; bias; pressure.

Introduction

In competitive sports, officials are required to make rapid and complex decisions, often in a highly pressured environment (Helsen & Bultynck, 2004). Moreover, their decisions often directly affect the outcome of competitions (Plessner & MacMahon, 2013). For example, during the final minutes of the 2015 Rugby World Cup quarter-final between Scotland and Australia, referee, Craig Joubert, decided to award a controversial penalty to Australia for a deliberate knock-on, resulting in a 35-34 victory for Australia, which enabled them to progress to the semi-final of the competition. Such decisions invariably attract negative evaluations by aggrieved players, coaches, spectators and the media, so the importance of consistent and impartial officiating is unquestionable (Stulp, Buunk, Verhulst, & Pollet, 2012).

Decision-making can be influenced by a variety of factors (MacMahon et al., 2015), such as home advantage and crowd noise (e.g., crowd noise contribution to the home advantage effect, Nevill, Hemingway, Greaves, Dallaway, & Devonport, 2016; Unkelbach & Memmert, 2010), competition level (Souchon, Cabagno, Traclet, Trouilloud, & Maio, 2009; Souchon et al., 2016), reputation (e.g., expectation bias in gymnastics, Plessner, 1999) and time (e.g., decision accuracy and frequency thoughout games, Emmonds et al., 2015; Mallo, Frutos, Juárez, & Navarro, 2012). In the current paper, we employ and exploratory approach to examine the decisions made by netball umpires and the influences of contextual and environmental factors on the number of decisions made. Moreover, we investigate umpires' self-reported tendency to reinvest in, and ruminate upon, their decisions.

Many researchers have focused upon the home advantage in sports – a phenomenon whereby there is an apparent advantage conferred to the home team. Four major determinants have been suggested to cause the home advantage effect namely, familiarity, territoriality,

travel fatigue, and crowd noise (Pollard, 2008). It has been suggested that home advantage fluctuates throughout the game. For example, in basketball, Jones (2007) demonstrated that the home advantage (difference in points scored by the home and away teams) was greatest in the first quarter. In volleyball, home teams had a greater advantage at the beginning (1st set) and towards the end of the game (4th and 5th sets); this effect has been attributed to familiarity with the venues and crowd effects (Marcelino, Mesquita, Palao, & Sampaio, 2009). In relation to the referee's influence on the home advantage, Boyko, Boyko, and Boyko (2007) examined data from 5,244 English Premier League soccer matches involving 50 referees. They found that referees differed in their susceptibility to the home advantage effect; hypothesising this was due to variations in the referees' ability to deal with social pressure. However, Johnston (2008) replicated Boyko et al.'s (2007) approach and found no evidence of such individual differences when removing referees who only officiated a few matches. To investigate this discrepancy further, Page and Page (2010) analysed footage from 37,830 national and international soccer matches across 58 competitions, between 1994 and 2007. Their analyses showed that not only did the size of the home advantage differ significantly between referees, but also, in line with Boyko et al. (2007), their decisions were moderated by crowd size – lending support to the notion that referees cope differently with the social pressure exerted by home crowds.

Using a video-based protocol, Nevill, Balmer, and Williams (2002) manipulated crowd noise presence ("loud" or none) and found that soccer referees made more decisions in favour of the home team, and in line with the original match referee. Unkelbach and Memmert (2010) identified the inherent limitation of testing crowd noise ("natural conditions") versus no crowd noise ("unnatural conditions"). The authors highlighted that Nevill et al's (2002) findings merely indicate that home crowd noise biases decisions

compared to no crowd noise, rather than crowd noise influencing referee decisions in favour of the home team. Subsequently, Unkelbach and Memmert (2010) tested the hypothesis that louder crowd noise would lead to more yellow cards awarded compared to low crowd noise. Twenty referees viewed 56 foul scenes, in which 50% led to the award of a yellow card and 50% did not. The high-volume crowd noise led to substantially more yellow cards than low-volume crowd noise. Further evidence in soccer indicates that home teams were awarded more penalties (e.g., Nevill, Newell, & Gale, 1996; Scoppa, 2008; Sutter & Kocher, 2004), and fewer yellow and red cards (Buraimo, Forrest, & Simmons, 2010) with the size of the attending crowd moderating these effects (Boyko et al., 2007).

The mediating effect of competition level has received scant attention, whilst stage of competition (e.g., Round 1, playoffs, finals, etc.) has yet to be investigated. Souchon et al. (2009) proposed that the level of competition is a stereotyping heuristic used by referees to form their decisions, interpreting fouls differently according to their preconceptions regarding the standard of play. Souchon et al. (2009) investigated this notion in handball (e.g., lower versus higher standard), predicting the level of competition effects would be greater for more difficult, ambiguous handball transgressions ("pushing offences", opposed to clearer "holding back" offences) and anticipating that referees would be more lenient in higher-standard competition. They reported that referees intervened less frequently at higher levels of competition and allowed play to continue without intervention more frequently following more ambiguous transgressions (pushing offences compared to holding offences). Similarly, Souchon et al. (2016) observed that referees intervened less often when higher- level players transgressed. The authors suggested that a reduction in decisions made may be the culmination of a number of factors: referees trying to maintain the flow of a match; referees making fewer calls to maintain the game's value as a spectacle (e.g., Mascarenhas, O'Hare, &

Plessner, 2006); that a greater number of fouls may be more ambiguous in high-level competition, due to the high speed of play; that greater levels of player aggressiveness may make it more difficult to identify transgressions; or that referees may assume that certain players can continue their actions despite the seriousness of the foul committed (e.g., gender stereotype and males superior physical ability, Souchon et al., 2010). In this study, we aim to examine potential changes in the number of decisions made across progressive competition rounds (perceived match importance arguably increases as the rounds progress).

Few researchers have focused on the effect of the competing teams' abilities on sports officials' judgements. However, Plessner (1999) examined the idea of an expectation bias in team gymnastics, where gymnasts normally perform in a ranked order, worst to best. Plessner predicted that when the same routines, placed in either first or fifth position, will score higher when the judges view them in the latter position. Forty-eight gymnastic judges, with prior expectations of coaches' rank order of the gymnasts, judged videotapes of a men's team competition. Their results supported the notion of an *ability expectation bias*, whereby, for difficult tasks (e.g., pommel horse, vault, and horizontal bar) the judges awarded greater scores when the target routines were presented fifth than if they were presented first. Findlay and Ste-Marie (2004) explored athlete reputation bias in figure skating judgments. Twelve judges evaluated performance of 14 skaters, half of whom were known to the judges. The performance of skaters with a pre-existing positive reputation were scored more highly than those of the unknown skaters. It is possible that similar unconscious biases relating to perceived athlete ability may also exist in team sports; hence, we also took the competing teams' pre-eminence (i.e., their league position) into account in this study.

To date, a limited body of research has investigated the effect of the match period on sports officials' decision-making. Mallo et al. (2012) assessed the soccer referees' decision

quality and quantity in relation to match periods. Mallo et al. reported that a greater number of incidents occurred in the last 15- minute period of matches – but the lowest referee decision accuracy (77%) was also observed during this period. They suggested that physical and mental fatigue occurs during the final stages of a match leading to impaired decision-making. Similarly, Emmonds et al. (2015) found a drop in penalty judgement accuracy in rugby league referees in the last 10 minutes of matches. Conversely, Mascarenhas, Button, O'Hare and Dicks (2009) reported that soccer referees were less accurate in the opening 15 minutes of each half than they were at any other period. They attributed poorer decision-making to warm up decrements, whereby their physical warm-up was not accompanied by a mental warm up techniques. Finally, Elsworthy, Burke and Dascombe (2014) investigated decision-making demands of Australian Football referees, and reported that the number of free kicks awarded and free kick accuracy did not differ across each quarter of the match. Accordingly, in the present study, we analysed differences in the number of decisions made by netball umpires across each of the four match quarters.

Published reports using qualitative methods have identified several sources of pressure and anxiety for sports officials (such as game importance, Hill, Matthews, & Senior, 2016; time, Morris & O'Connor, 2016; social pressure, Schnyder & Hossner, 2016). Morris and O'Connor (2016) found that National Rugby League (NRL) referees identified the time during a match as an influence on their game management strategies and decision-making ability. For example, one referee stated "certain decisions can have a greater impact at different stages in a game which can increase media scrutiny" (Morris & O'Connor, 2016, p.854). Schnynder and Hossner (2016) interviewed high-level soccer referees regarding decision-making and the difficulties they face. Several of the referees identified social pressures, including pressure from the media, teams, football associations and even

themselves. Hill, Matthews, and Senior (2016) interviewed seven expert rugby referees and noted that avoidance coping behaviours were regularly employed to deal with multiple stressors that influence their performance including: unfamiliarity (e.g., new situations); performance errors (e.g., mistakes that 'harm' players, coaches and own career prospects); interpersonal conflict (e.g., manging player hostility); game importance (e.g., when the match outcome held significant consequence for players such as a final, or for themselves such as games close to renewal of contracts) and self-presentational concerns (e.g., fear of negative evaluation by selectors, avoiding criticism that could damage their confidence and reputation). The avoidance behaviours manifested themselves as denial after performance errors, rushing or withdrawal during the game, and a lack of preparation leading into games. Similarly, overt and maladaptive changes in behaviour under anxiogenic conditions have been observed in soccer (Jordet & Hartman, 2008) in climbing (Nieuwenhuys, Pijpers, Oudejans, & Bakker, 2008), dart throwing (Nibbeling, Oudejans, & Daanen, 2012), golf (Hill, Hanton, Matthews, & Fleming, 2010), and police arrest procedures (Renden et al., 2014).

Decision avoidance has been described as "a tendency to avoid making a choice, by postponing it or by seeking an easy way out that involves no action or no change" (Anderson, 2003, p. 139). Selection difficulty has been identified as a major contributor to decision avoidance including factors such as: reasoning; preference uncertainty; attractiveness of options; attentional focus; time limitation; negative emotion (associated with blame and regret); and conflict type (Anderson, 2003). Researchers have shown that decision averseness occurs when situations have inequitable outcomes for others – particularly when the decision maker is held accountable (Beattie, Baron, Hershey, & Spranca, 1994); and the likelihood of negative outcomes also increases negative emotions associated with such decisions (Luce,

Bettman, & Payne, 1997). In this study, we explored the notion that withdrawal of decisions (fewer decisions made) may be an example of decision avoidance behaviour.

Several theories have been proposed to explain performance decrements under pressure. A prominent example is Reinvestment Theory (Masters, 1992). Reinvestment is defined as the "propensity for manipulation of conscious, explicit rule based knowledge, by working memory, to control the mechanics of one's movements during motor output" (Masters & Maxwell, 2004, p.208). Consequently, the use of explicit knowledge to consciously control normally automatic movements typically results in performance decrements or outright failure. Researchers have demonstrated that, when performing well-learnt motor skills or complex cognitive tasks, individuals who have a strong tendency to reinvest (as measured by the Reinvestment Scale, Masters et al., 1993) (as measured by the Reinvestment Scale) are more susceptible to poor performance under pressure (Jackson, Kinrade, Hicks, & Wills, 2013; Kinrade, Jackson, & Ashford, 2010).

To address potentially differential effects of reinvestment on motor skill execution and decision-making, Kinrade, Jackson, Ashford and Bishop (2010) modified the original scale to create a decision-specific version focusing on individuals' propensity to deliberate, and ruminate, on their decisions – the Decision-Specific Reinvestment Scale (DSRS). Kinrade et al. (2010) proposed two explanations for the breakdown of decision-making under pressure. First, that conscious processing of explicit information results in poor decision-making, by interfering with normal automatic processes (Decision Reinvestment; e.g., "I'm aware of the way my mind works when I make a decision"). Secondly, ruminative thoughts (e.g., over past poor decisions) lead to poor decision-making by drawing processing resources away from the task at hand (Decision Rumination; e.g., "I remember poor decisions I make for a long time afterwards"). Kinrade et al., (2010) described rumination as a thought process

that typically involves repetitive negative thoughts about past events or current mood states. Higher decision reinvesters and ruminators tend to exhibit poorer working memory task performance, (Laborde, Furley, & Schempp, 2015) and poorer decision-making performance in complex tasks (Kinrade, Jackson, & Ashford, 2015). Kinrade et al., (2015) suggested that ruminative thoughts may occupy working memory capacity at a time when executive functions are already in great demand to complete the primary task. Poolton, Sui and Masters (2011) used the DSRS to examine soccer referees' susceptibility to the home advantage effect. Twenty-eight experienced referees were asked to make decisions when viewing game footage of two opposing players competing for the ball, by stating which player committed the foul. Referees that emerged as 'high decision ruminators' disproportionately made decisions in favour of the home team. We aim to explore this link further in the present study, in the context of netball officiating.

In order to more fully understand contextual and dispositional influences on the decision-making of netball umpires, we used performance analysis to examine decisions made by umpires during matches in the England Netball Superleague – the highest echelon of competitive netball in the UK. We explored not only environmental and contextual influences such as crowd size, but also the umpires' self-reported tendency to reinvest in, and ruminate upon, their decisions. The number of decisions made provided an overt manifestation of the observed umpires' behaviour, a technique previously used to categorise observational data into approach- and avoidance-type behaviours (Jordet & Hartman, 2008). In accordance with previous research (Anderson, 2003; Hill et al., 2016; Jordet & Hartman, 2008; Nevill et al., 2002; Poolton et al., 2011; Souchon et al., 2016), we tentatively hypothesised that umpires' decision frequency would be mediated by environmental/ contextual influences such as home team status, crowd size, match prominence, league position, and time during the match. More

explicitly, we predicted that, home teams in the presence of larger crowds, greater match significance, more prominent teams, and early match quarters would each be associated with lower decision frequencies (i.e., avoidance behaviour). We also predicted that a tendency to reinvest and ruminate would be associated with inhibited decision-making.

Method

Participants

Altogether, 15 umpires officiated in the Superleague during the 2014 season, umpiring approximately eight matches each (M = 8.067, SD = 3.77). From this original sample 10 umpires (M age = 39.6 yrs, SD = 9.38 yrs) with a mean total years' experience of 14.5 years (M = 14.5 yrs, SD = 7.66 yrs), qualified at international (International Umpire Award) or national level (A-award), completed the DSRS. On average, they officiated almost nine matches each throughout the season (M = 8.80, SD = 2.859).

Measures

Data Acquisition. Video footage from sixty Netball Superleague 2014 season matches was obtained. Crowd size (number of people present in the crowd) data were collected from the individual teams for their home fixtures and from England Netball for all 'neutral' venues (i.e., those for which there was no home team). League table data for each round were obtained from England Netball. Approval was obtained from the lead institution's local ethics committee.

Variables. All coded variables were derived from discussions with a panel of experts (an England Netball Officiating Manager, a retired international umpire and assessor, a current national level umpire and tutor) and in accordance with variables previously shown to be pertinent with regard to sports officials' decision-making (e.g., match importance, Hill et al., 2016; Decision Rumination and the home advantage effect, Poolton et al., 2011). The

primary dependent variable was the number of observable decisions made (NoD), split into three subcategories: overall; those against the home team; and those against the away team. Other coded variables included: infringement type (*contact*, *obstruction*, *offside*, *breaking*, *out of court*, and *other infringement*); and sanctions imposed (*penalty pass*, *advantage*, *throw in*, *advantage goal*, *other sanction.*). Additionally, we recorded six variables that were hypothesised to have a potential influence on umpires' decision-making: crowd size; competition round number (e.g., 1 = 1st round); league positions (of home teams, of away teams, and average; 1 = top of the league); and match quarter (e.g., Q1 = 1st quarter).

Decision Specific Reinvestment Scale. Altogether, 10 umpires completed the Decision-Specific Reinvestment Scale (DSRS, Kinrade et al., 2010), a 13-item scale, comprising two subscales (Decision Reinvestment and Decision Rumination). Participants responded to each of the 13 items using a 5-point Likert scale anchored by 0 ("extremely uncharacteristic") and 4 ("extremely characteristic"). The Decision Reinvestment subscale comprises 6 items, assessing the individual's propensity to consciously monitor their decision-making processes, with scores ranging from 0 to 24. The Decision Rumination subscale comprises 7 items, assessing tendency to negatively evaluate previous poor decisions, with scores ranging from 0 to 28. Kinrade et al. (2010) reported an internal consistency of .89 for the Decision Reinvestment subscale items and .91 for the Decision Rumination subscale items.

Procedure

The matches were analysed using digital performance analysis software (Sportscode Elite Version 9, Sportstec, Australia). A self-devised code window was designed to collect the number of observable decisions, based on arm signals and vocalisations made by the umpires during the matches. Observable decisions were infringements that were registered

and acted upon by the official by either a whistle blow or signalling advantage (this did not include time calls e.g., injury, blood). Also, umpires can decide not to interfere with play (Helsen & Bultynck, 2004) and these non-observable decisions were not recorded. Situations in which decisions were unclear were coded separately (accounting for 1.4% of total decisions made). Two researchers independently coded all the footage; intraclass correlation coefficients were used to test for inter and intra-observer reliability (ICC >.90 for all).

Data Analyses

Preliminary screening of all data, using univariate z-scores (> ± 3.29) and multivariate Mahalanobis distance values revealed one outlier from both the match and umpire data set which were removed. The data were normally distributed.

A repeated-measures ANOVA was completed to compare differences in the NoD made across quarters. The relationships between contextual/ environmental influences, dispositional tendencies, and decision-making were examined using two different analyses: one in which matches were treated as cases (n = 59), and another in which umpires were cases (n = 15 [all umpires] or n = 10 [DSRS completer's only, accounting for 72% of all matches, n = 42]). Pearson's product moment correlation coefficient was calculated for all bivariate combinations of the following variables in the match analyses: NoD; per match and per quarter; overall, in favour of home teams and in favour of away teams; crowd size; competitive round number; and home, and away team league positions, and their average. For the umpire analyses, bivariate correlations included total years of experience, Reinvestment, Rumination and number of games umpired. For the match-level analysis, all variables that were significantly related to NoD were entered as predictors into two stepwise multiple regression analyses and one linear regression, in which backward elimination was used in order to find a model that best explained the data. NoD, NoD Away, and NoD Home were

the criterion measures for each of the three models. Alpha was set at .05 for all statistical tests. Due to the exploratory nature of the study, and accordingly tentative but directional nature of the hypotheses, we made no correction for multiple comparisons.

Results

Descriptive statistics

The descriptive statistics are presented in Table 1. On average, umpires made 120 observable decisions per game (M = 120.41, SE = 4.07). A repeated-measures ANOVA indicated that more decisions were made in the first quarter (M = 33.02, SE = 1.14) than in the third (M = 29.63, SE = 1.16) and fourth (M = 27.72, SE = 1.61) quarters, (F (3, 39) = 4.811, p = .006, η_p^2 = .270). The most common infringement type was contact (M = 45.69, SE = 1.04), and the most frequently awarded sanction was a penalty (M = 48.77, SE = 1.37). Descriptive statistics revealed that DSRS scores ranged from 15 to 35 (DSRS Global M = 25.50, SD = 6.67), and Reinvestment subscale score from 7 to 16 (Reinvestment M = 12.8, SD = 2.82), and Rumination subscale score from 4 to 20 (Rumination M = 12.7, SD = 5.42).

Match-level Analysis

Total NoD. All match-level bivariate correlations are presented in Table 2. NoD decreased as the average league position of the two teams increased (r = -.269, p = .040); that is, the higher the positions of the two teams, the greater the NoD. Similarly, the higher the home team league position (NB: top position in the league = 1), the greater the NoD (r = -.259, p = .047). As the teams progressed through the competition rounds, NoD increased (r = 266, p = .042). A backward stepwise regression was completed to identify the best predictors for NoD (variables entered: average league position, round, and home league position). The model that best predicted NoD included round and average team position (F (2, 58) = 3.919, p = .026, R^2_{Adjusted} = .091), although, when considered individually, neither predictor

contributed significantly; they only approached significance (round p= .078, average team position p= .074) (see Table 3).

NoD Home. NoD Home increased with the away team's league position (r = -.340, p = .008). A linear regression indicated that away league position was a significant predictor of NoD (Home) (F (1, 54) = 6.255, p = .016, R^2Adjusted = .089) (see Table 3).

NoD Away. NoD Away increased as home teams' positions improved (r = -.424, p = .001). As away teams progressed through rounds (r = .344, p = .008) or played in front of larger crowds (r = .312, p = .023) the NoD against them increased. A multiple regression was run to identify the best predictors for NoD Away (variables entered crowd size, round, and home league position) using the backward method. After the exclusion of crowd size and round, home team league position was shown to best predict NoD Away (F (1, 48) = 7.940, p = .007, R^2Adjusted = .126). (See Table 3).

Umpire Level Analysis

Total NoD. The total number of match decisions was not significantly correlated with any of the influences. As the average league position improved the number of decisions were greater (r = -.573, p = .032).

NoD Home. NoD Home increased as the competition progressed (i.e. later rounds, r = -.618, p = .018) and the away team's league position became more prominent (r = -.603, p = .022).

NoD Away. As crowd size increased so did the NoD Away (r = .560, p = .037) (see Table 4).

DSRS. The correlations completed with the DSRS subscales include only the data from the ten umpires who completed the scale. The Rumination subscale score was significantly negatively associated with NoD Q1 (r = -.795, p = .006), NoD Q3 (r = -.709, p

359 = 022), NoD Home Q1 (r = -.717, p = .020) and NoD Home Q3 decisions (r = -.660, p =

360 .038); that is, higher Rumination subscale scores were associated with fewer decisions.

361 Reinvestment subscale scores were not significantly correlated with any NoD variables.

362 Table 1. *Descriptive statistics-by umpire*

Variable		Mean	Std Error	Range
Total number of decisions (NoD)		120.41	4.07	98.54 - 158.03
	Q1	33.02	1.14	26.71 - 40.38
	Q2	30.04	1.43	20.72 - 46.00
	Q3	29.63	1.16	23.67 - 38.13
	Q4	27.72	1.61	15.00 - 42.50
Decisions against home team (NoD Home)		59.74	1.80	43.00 - 68.57
	Q1	17.80	1.19	12.14 - 27.17
	Q2	13.74	0.82	8.83 - 18.42
	Q3	15.04	1.16	10.00 - 23.50
	Q4	13.17	1.06	5.00 - 18.56
Decisions against away team (NoD Away)		60.31	2.96	45.27 - 90.83
	Q1	15.18	.784	9.33 - 22.00
	Q2	16.38	1.87	7.09 - 37.16
	Q3	14.39	.684	9.33 - 18.14
	Q4	14.36	1.758	7.64 - 35.00
Neutral venue team match decisions		68.05	2.87	60.5 - 73
Simultaneous Match decisions		0.13	0.07	0 - 0.33
Infringements	Contact	45.69	1.04	39-52.3
	Obstruction	39.83	3.07	19-63.8
	Offside	6.68	0.48	4.11-10.2
	Breaking	6.21	0.62	2.2-10
	Out	17.29	0.70	13.7-24
	Other Infringement (n = 11)	6.07	0.41	2.56-8.44
Sanctions	Penalty	48.77	1.37	39-61.2
	Free	8.43	0.37	6.30-11.60
	Advantage	35.48	2.81	21.33-62.8
	Advantage Goal	9.02	0.83	3.00-16.13
	Throw in	17.27	0.71	13.4-24.00
	Other Penalty (n = 6)	1.43	0.34	0-4.5.00

363

364 *Note.* Neutral venue team match decisions refer to the average number of decisions

365 against teams at neutral grounds (n = 2, final and 3rd/4th play off matches). Simultaneous

366 match decisions refer to the number of decisions whereby no clear sanction could be awarded
367 against a specific team, and results in a toss-up.

Table 2.

Correlational Analysis – by Match (n = 59)

	Total NoD					NoD (Home)					NoD (Away)				
	Match	Q1	Q2	Q3	Q4	Match	Q1	Q2	Q3	Q4	Match	Q1	Q2	Q3	Q4
Round Number	.266*	.188	.173	.279*	.191	.042	.046	.045	.064	-.048	.344**	.220	.170	.276*	.256
Home League Position	-.258*	-.152	-.233	-.211	-.231	.069	-.027	.171	-.060	.129	-.424**	-.188	-.413**	-.200	-.362**
Away League Position	-.063	-.215	.069	-.116	.116	-.340**	-.285*	-.232	-.258*	-.147	.186	-.043	.266*	.052	.244
Average Team Position	-.269*	-.305*	-.139	-.273*	-.098	-.223	-.258*	-.048	-.263*	-.013	-.203	-.193	-.128	-.126	-.104
Crowd Size	.236	.205	.171	.194	.170	.025	.128	-.160	.174	-.118	.312*	.167	.337*	.099	.286*

Note. Q= Quarter.*p<.05, ** p<.01.

Table 3.

Multiple and Linear Regression Data

		b	*SEB*	β	*p*
NoD					
Step 1	Constant	255.360	21.205		.000
	Average League Position	-5.160	4.685	-.175	.276
	Home League Position	-1.724	2.850	-.098	.548
	Round	1.974	1.213	.212	.109
$R^2_{Adjusted} = .081$, $\Delta R^2 = .129$					
Step 2	Constant	253.939	20.955		.000
	Average League Position	-6.840	3.752	-.231	.074
	Round	2.122	1.181	.228	.078
$R^2_{Adjusted} = .091$, $\Delta R^2 = -.006$					
NoD Home					
	Constant	135.102	6.641		.000
	Away League Position	-3.299	1.319	-.325	.016
$R^2_{Adjusted} = .089$, $\Delta R^2 = .106$					
NoD Away					
Step 1	Constant	116.949	27.269		.000
	Crowd Size	.013	.027	.085	.642
	Home League Position	-3.711	2.289	-.297	.112
	Round	1.399	.971	.195	.156
$R^2_{Adjusted} = .186$, $\Delta R^2 = .186$					
Step 2	Constant	128.369	12.000		.000
	Home League Position	-4.430	1.679	-.355	.011
	Round	1.396	.962	.195	.154
$R^2_{Adjusted} = .182$, $\Delta R^2 = -.004$					
Step 3	Constant	140.132	8.950		.000
	Home League Position	-4.746	1.684	-.380	.007
$R^2_{Adjusted} = .126$, $\Delta R^2 = -.037$					

Table 4.

Umpire data set correlations

	Total NoD					NoD (Home)					NoD (Away)				
	Match	Q1	Q2	Q3	Q4	Match	Q1	Q2	Q3	Q4	Match	Q1	Q2	Q3	Q4
Years Exp	-.099	-.044	-.096	-.129	-.172	-.048	-.284	.390	-.304	.461	-.222	.107	-.198	.177	-.254
Number umpired	-.128	-.094	-.383	-.170	.207	.230	-.392	.564*	-.218	.633*	-.363	.625*	-.602*	.177	-.318
Reinvestment	-.221	-.088	-.252	-.124	-.218	-.081	-.346	.474	-.204	.288	-.318	.549	-.397	.061	-.313
Rumination	-.586	-.795**	-.361	-.709*	-.334	-.550	-.717*	.567	-.660*	.621	-.584	.179	-.505	.032	-.530
Crowd Size	.346	.383	.443	.202	.104	-.094	.298	-.409	.263	-.467	.560*	.100	.492	.020	.367
Round	-.152	-.095	.185	-.102	-.441	-.618*	-.101	-.281	-.209	-.488	.201	-.112	.346	.078	-.010
League Position	-.406	-.254	-.330	-.573*	-.151	-.255	-.321	.149	-.399	.250	-.324	.248	-.291	-.102	-.306
Home League Position	.136	.140	-.015	-.146	.410	.458	-.012	.375	-.004	.503	-.064	.299	-.202	-.096	.011
Away League Position	-.209	-.183	.092	-.399	-.225	-.603*	-.051	-.420	-.226	-.393	.164	-.125	.309	-.174	.070

Note. Q= Quarter. *p<.05, ** p<.01

Discussion

In an exploratory study, we examined the influence of contextual and dispositional differences on decision-making of umpires in actual match settings. We hypothesised, based on existing literature, that environmental and contextual influences (i.e., larger crowds, more prominent teams, greater match significance, and early quarters) would be associated with lower decision frequencies. Furthermore, we predicted that inhibited decision-making would be associated with a dispositional tendency to reinvest and ruminate. In line with our hypotheses, match prominence and league position were associated with a reduction in the number of decisions. The Decision Rumination factor was linked with inhibited decision making; but contrary to our hypothesis, the Reinvestment factor was unrelated. In contrast to our hypotheses, increasing crowd size was associated with a greater number of decisions, particularly against away teams; and the number of decisions diminished throughout a match.

Our data indicated that more decisions were made in Q1 (33 decisions) than in Q3 (29 decisions) and Q4 (27 decisions), incongruent to our hypothesis and the findings by Mallo et al. (2012) and Elsworthy et al. (2014). These differences could be related to physical fitness and fatigue of umpires; for example, Paget (2015) found that the distance covered by netball umpires was significantly reduced in the fourth quarter. It is possible that, if umpires are physically fatigued and not covering the same distances as they did in the early stages of a match, the fewer decisions later in the game could be those missed or avoided as a result of incorrect positioning. Multiple researchers have highlighted the link between position (distance and angle) of soccer referees and decision performance (e.g., Gilis, Helsen, Catteeuw, & Wagemans, 2008; Mallo et al., 2012; Oudejans et al., 2000; Oudejans et al., 2005). For example, Mallo et al. (2012) demonstrated referees had a lower number of incorrect decisions when the referees were positioned in the central area of the field.

Research in medical and military settings has shown that fatigue and physical exertion have a detrimental effect on decision-making (e.g., Kovacs & Croskerry, 1999; Larsen, 2001). However, in sport contexts, decision-making performance was shown to be unaffected by physical exertion in Australian football umpires (Elsworthy, Burke, Scott, Stevens, & Dascombe, 2014; Paradis, Larkin, & O'Connor, 2015), fatigue in English Premier League assistant referees (Catteeuw, Gilis, Wagemans, & Helsen, 2010) or physical performance of New Zealand Football Championship referees (Mascarenhas et al., 2009). Thus, it is possible the change in the number of decisions is in response to the reducing work rate of the players or level of performance. For example, Weston and colleagues (Weston, Bird, Helsen, Nevill, & Castagna, 2006; Weston et al., 2012) found that soccer referees and players high intensity running distance, ball travel, and total distance covered were correlated. However, further research is required to understand the link between player and referee physical performances and their impact on referee decision-making.

As suggested by Poolton et al (2011), higher Rumination subscale scores, and not Reinvestment scores, were strongly associated ($r > -.7$) with fewer decisions in Q1 and Q3. Notably, higher ruminators made fewer decisions against home teams during those quarters. Burke, Joyner, Pim, and Czech (2000) demonstrated that basketball officials' cognitive anxiety was higher pre-game, and at half time when compared to post-game. It is possible that prior to the start of the game, where officials arrive at the venue early and watch the teams' warm-up pre-game, and during the half-time break, there is greater potential for officials to engage in ruminative thoughts than during the smaller breaks taken between Quarters 1 and 2, and 3 and 4. To our knowledge, no researchers have investigated the timing of sports officials' decision ruminations. However, Roy, Memmert, Frees, Radzevick, Pretz and Noel (2016) explored the timing of rumination by asking hockey players to rate on a 5-

point scale whether they would continue to think about the play when it was over and their role in the play (past play), and how the team and individual would perform in the rest of the match (future play). Their results indicated that participants were unlikely to think about previous play after it was over, or about how the game would unfold; however, they were more likely to think about past play than future play. The authors suggested that the low rumination observed in successful field hockey players could reflect that people low in rumination do best in tasks requiring quick shifts of attention (such as dynamic team sports). Alternatively, a possible explanation might be that umpires engage in avoidance behaviours to reduce the chance of scrutiny of their decisions (Anderson, 2003). Contrary to our hypothesis, but consistent with Poolton et al. (2011), Reinvestment subscales scores were not related to the number of decisions.

A home advantage effect was observed; the descriptive statistics indicated that more decisions were awarded against away teams, supporting findings in soccer, that home teams were awarded more penalties (Nevill et al., 1996) and that more yellow cards were awarded to away teams (Goumas, 2014). Factors purported to contribute to the home advantage include travel (i.e. greater time and distances for the away team), referee bias, familiarity and crowd size (Pollard, 2008). Furthermore, the correlations suggested that for matches in later rounds, where there is often greater importance due to more matches influencing final placings, play-offs and finals, fewer decisions were awarded against home teams. One explanation could be that officials exhibit avoidance-type behaviours to cope with the increases in anxiety resulting from increased perceived importance. Hill et al. (2016) found that rugby referees highlighted the importance of the game as one of the stressors affecting their performance, and that some referees use avoidance coping methods (e.g., Jordet & Hartman, 2008) to manage this stressor. It is possible that umpire experience could have

449 confounded these figures, however a correlation between round and the umpires years of
450 experience, where you might expect the most experienced umpires to officiate the latter
451 rounds, was non-significant (r = .126, p = 728).

452 Our results are consistent with previous research (e.g., Boyko et al., 2007; Page &
453 Page, 2010) where increases in crowd size were associated with an increase in the number of
454 decisions against away teams. One possible explanation is that when faced with a difficult
455 decision, officials draw on other salient cues (e.g., crowd noise), particularly when placed
456 under time constraints (Balmer et al., 2007). In order to reduce the complexity of a decision
457 (Souchon et al., 2010) umpires' may use simple heuristics (Raab, 2012). For example, if two
458 opposing players contested a ball and the umpire was unsure of the penalty decision, they
459 may place equal weight on the auditory crowd cues as they do their visual information.
460 Crowd noise typically favours the home team, resulting in more decisions against away teams
461 (Nevill & Holder, 1999). This finding is reflected in our data, with larger crowd sizes
462 associated with more decisions against away teams. Alternatively, researchers have reported
463 that crowd noise induces a reluctance to penalise the home team (Nevill et al., 2002) (i.e., an
464 absence of crowd noise indicates to the referee that no serious offence has been committed).

465 The number of years' experience was not associated with the number of decisions
466 made. This may be due to the number of years' experience umpiring at Superleague level
467 (which was not recorded) or that there was little to no difference in qualification (Hancock &
468 Ste-Marie, 2013). Other researchers have found the referee's experience to influence decision
469 -making. Nevill et al. (2002) found as referees experience increased, that more fouls were
470 awarded against home players, until a peak of 16 years, where upon a decline was then
471 observed. However, the number of games umpired was positively associated with

Reinvestment subscale scores. Potentially, those umpires who deliberate more on their decisions are deemed more effective and are therefore requested to umpire more often.

League position predicted fewer decisions against home teams when playing lower positioned away teams, and for away teams playing lower positioned home teams. This finding may be similar to the reputation bias of judges found by Findlay and Ste-Marie (2004) and Plessner (1999) whereby teams with a better performance reputation may be sanctioned less. Alternatively, it is possible that the results of this study could be explained by the differences in players (e.g., lower ability teams or less competitive matches), or players' susceptibility to pressure, and not that of the officials. Previously, researchers have reported that yellow cards against away players in soccer could be a consequence of a poorer psychological state when compared with playing at home (Bray, Jones, & Owen, 2002; Terry, Walrond, & Carron, 1998).

There were several limitations that need to be acknowledged. First, we had incomplete data for crowd size, resulting in six matches being excluded from the crowd size analyses. Similarly, not all umpires who officiated the season completed the DSRS and were therefore excluded from the correlational analyses. However, those who did complete the DSRS officiated 72% of the matches analysed. Second, the accuracy of decisions was not recorded, preventing insight into the performance change of umpires exposed to different contextual and environmental conditions or comparisons between those with greater or lesser disposition to ruminate. However, it was not practically possible to obtain objective assessments of every decision made by the officials across the season. We also acknowledge that rumination is often seen as a negative process (referring to passive self-critical worrisome or anxious thinking, Trapnell, & Campbell, 1999; Treynor, Gonzalez, Nolen-Hoeksema, 2003), whereas self-reflection (considered to be a motivated process aimed at

understanding in the self and overcoming problems and difficulties, Trapnell, & Campbell, 1999; Treynor et al., 2003) on performance is an important post-game learning tool used by sports officials (MacMahon et al.,2015). Although the DSRS items refer to negative ruminative thoughts, our study design did not allow us to collect data on the types or timings of rumination/reflection. Further investigation is required to examine the relationship between rumination and performance in sports officials, with reference to the types (rumination versus reflection) and timings (before, during, and after performance) of ruminations officials' make through self-report or stimulated recall.

Third, we cannot isolate the influence of each potential bias using the current study design. The number of decisions umpires make may be a result of a combined effect of crowd sizes, league position, round, and time. For example, you might expect later rounds to have greater crowd sizes, which could have confounded our data. However, a correlation between round and crowd size, was not significant (r = .136 p = .326). It would be beneficial to investigate these effects in isolation in a controlled environment in order to draw clearer conclusions regarding the potential influence of these factors. Furthermore, we cannot be certain that the players' performance was not affected by the same contextual, environmental or dispositional influences, leading the umpires to adjust their decision-making accordingly. Finally, we used observational data and descriptive and correlational analyses. An advantage of the use of observational data is the high external validity, making the results easily interpretable and applicable in the real world. While our approach is novel and the study presents the first empirically based analysis of netball officiating behaviour we cannot infer causality from the findings. In future, controlled experiments are required to establish any causal links that may be implied in our data. For example, future research should examine the specific crowd factors that lead to changes in decision-making behaviour such as examining

520 the impact of volume on decision-making, where crowd size has been linked to crowd noise
521 (Hayne, Taylor, Rumble, & Mee, 2011); or investigating the semantics of crowd members
522 (e.g., relevant or irrelevant to the decision, Bishop, Moore, Horne, & Teszka, 2014).

523 In summary, we explored putative contextual/environmental and dispositional
524 influences on netball umpires' decision-making. We observed a home advantage effect,
525 whereby more decisions were awarded against away teams when crowd sizes were greater.
526 We found a reduction in the number of observable decisions made, against teams with higher
527 status, in more important matches, as the time played in a match decreased and as a function
528 of increasing levels of Decision Rumination. Our study presents the first empirically-driven
529 task analysis of the demands of refereeing in netball and highlights a number of key areas for
530 which follow-up research comprising experimental designs and manipulations may be
531 employed.

532 **References**

533 Anderson, C. J. (2003). The psychology of doing nothing: Forms of decision avoidance result
534 from reason and emotion. *Psychological Bulletin, 129*(1), 139.

535 Balmer, N. J., Nevill, A. M., Lane, A. M., Ward, P., Williams, A. M., & Fairclough, S. H.
536 (2007). Influence of crowd noise on soccer refereeing consistency in soccer. *Journal of*
537 *Sport Behavior, 30*(2), 130.

538 Beattie, J., Baron, J., Hershey, J. C., & Spranca, M. D. (1994). Psychological determinants of
539 decision attitude. *Journal of Behavioral Decision Making, 7*(2), 129-144.

Bishop, D. T., Moore, S., Horne, S., & Teszka, R. (2014). Attentional capture by spoken language: Effects on netballers' visual task performance. *Journal of Sports Sciences, 32*(17), 1611-1620. doi:10.1080/02640414.2014.908323

Boyko, R. H., Boyko, A. R., & Boyko, M. G. (2007). Referee bias contributes to home advantage in english premiership football. *Journal of Sports Sciences, 25*(11), 1185-1194. doi:10.1080/02640410601038576

Bray, S. R., Jones, M. V., & Owen, S. (2002). The influence of competition location on athletes' psychological states. *Journal of Sport Behavior, 25*(3), 231.

Buraimo, B., Forrest, D., & Simmons, R. (2010). The 12th man?: Refereeing bias in english and german soccer. *Journal of the Royal Statistical Society: Series A (Statistics in Society), 173*(2), 431-449. doi:10.1111/j.1467-985X.2009.00604.x

Burke, K. L., Joyner, A. B., Pim, A., & Czech, D. R. (2000). An exploratory investigation of the perceptions of aniexty among basketball officials before, during, and after the contest. *Journal of Sport Behavior, 23*(1), 11.

Catteeuw, P., Gilis, B., Wagemans, J., & Helsen, W. (2010). Offside decision making of assistant referees in the english premier league: Impact of physical and perceptual-cognitive factors on match performance. *Journal of Sports Sciences, 28*(5), 471-481. doi:10.1080/02640410903518184

Elsworthy, N., Burke, D., & Dascombe, B. (2014). Factors relating to the decision-making performance of australian football officials. *International Journal of Performance Analysis in Sport, 14*(2), 401-410.

561 Elsworthy, N., Burke, D., Scott, B. R., Stevens, C. J., & Dascombe, B. J. (2014). Physical
562 and decision-making demands of australian football umpires during competitive
563 matches. *Journal of Strength and Conditioning Research, 28*(12), 3502-3507.
564 doi:10.1519/JSC.0000000000000567 [doi]

565 Emmonds, S., O'Hara, J., Till, K., Jones, B., Brightmore, A., & Cooke, C. (2015).
566 Physiological and movement demands of rugby league referees: Influence on penalty
567 accuracy. *Journal of Strength and Conditioning Research, 29*(12), 3367-3374.
568 doi:10.1519/JSC.0000000000001002 [doi]

569 Findlay, L. C., & Ste-Marie, D. M. (2004). A reputation bias in figure skating judging.
570 *Journal of Sport and Exercise Psychology, 26*(1), 154-166. doi:10.1123/jsep.26.1.154

571 Gilis, B., Helsen, W., Catteeuw, P., & Wagemans, J. (2008). Offside decisions by expert
572 assistant referees in association football: Perception and recall of spatial positions in
573 complex dynamic events. *Journal of Experimental Psychology.Applied, 14*(1), 21-35.
574 doi:10.1037/1076-898X.14.1.21

575 Goumas, C. (2014). Home advantage in australian soccer. *Journal of Science and Medicine in*
576 *Sport, 17*(1), 119-123. doi:10.1016/j.jsams.2013.02.014

577 Hancock, D. J., & Ste-Marie, D. M. (2013). Gaze behaviors and decision making accuracy of
578 higher-and lower-level ice hockey referees. *Psychology of Sport and Exercise, 14*(1), 66-
579 71. doi:10.1016/j.psychsport.2012.08.002

580 Hayne, M. J., Taylor, J. C., Rumble, R. H., & Mee, D. J. (2011). Prediction of noise from
581 small to medium sized crowds. *Acoustics*, Gold Coast, Australia.

582 Helsen, W., & Bultynck, J. (2004). Physical and perceptual-cognitive demands of top-class
583 refereeing in association football. *Journal of Sports Sciences, 22*(2), 179-189.
584 doi:10.1080/02640410310001641502

585 Hill, D. M., Hanton, S., Matthews, N., & Fleming, S. (2010). A qualitative exploration of
586 choking in elite golf. *Journal of Clinical Sport Psychology, 4*(3), 221-240.
587 doi:10.1123/jcsp.4.3.221

588 Hill, D. M., Matthews, N., & Senior, R. (2016). The psychological characteristics of
589 performance under pressure in professional rugby union referees. *The Sport*
590 *Psychologist, Advance online publication* doi:10.1123/tsp.2015-0109

591 Jackson, R. C., Kinrade, N. P., Hicks, T., & Wills, R. (2013). Individual propensity for
592 reinvestment: Field-based evidence for the predictive validity of three scales.
593 *International Jounral of Sport Psychology, 44*(4), 331-350.
594 doi:10.7352/IJSP2013.44.331

595 Johnston, R. (2008). On referee bias, crowd size, and home advantage in the english soccer
596 premiership. *Journal of Sports Sciences, 26*(6), 563-568.
597 doi:10.1080/02640410701736780

598 Jones, M. (2007). Home advantage in the NBA as a game-long process. *Journal of*
599 *Quantitative Analysis in Sports, 3*(4), 2-14. doi:10.2202/1559-0410.1081

600 Jordet, G., & Hartman, E. (2008). Avoidance motivation and choking under pressure in
601 soccer penalty shootouts. *Journal of Sport & Exercise Psychology, 30*(4), 450-457.
602 doi:10.1123/jsep.30.4.450

603 Kinrade, N. P., Jackson, R. C., & Ashford, K. J. (2015). Reinvestment, task complexity and
604 decision making under pressure in basketball. *Psychology of Sport and Exercise, 20*, 11-
605 19. doi:10.1016/j.psychsport.2015.03.007

606 Kinrade, N. P., Jackson, R. C., & Ashford, K. J. (2010). Dispositional reinvestment and skill
607 failure in cognitive and motor tasks. *Psychology of Sport & Exercise, 11*(4), 312-319.
608 doi:10.1016/j.psychsport.2010.02.005

609 Kinrade, N. P., Jackson, R. C., Ashford, K. J., & Bishop, D. T. (2010). Development and
610 validation of the decision-specific reinvestment scale. *Journal of Sports Sciences,*
611 *28*(10), 1127-1135. doi:10.1080/02640414.2010.499439

612 Kovacs, G., & Croskerry, P. (1999). Clinical decision making: An emergency medicine
613 perspective. *Academic Emergency Medicine, 6*(9), 947-952. doi:10.1111/j.1553-
614 2712.1999.tb01246.x

615 Laborde, S., Furley, P., & Schempp, C. (2015). The relationship between working memory,
616 reinvestment, and heart rate variability. *Physiology & Behavior, 139*, 430-436.
617 doi:10.1016/j.physbeh.2014.11.036

618 Larsen, R. P. (2001). Decision making by military students under severe stress. *Military*
619 *Psychology, 13*(2), 89-98. doi:10.1207/S15327876MP1302_02

620 Luce, M. F., Bettman, J. R., & Payne, J. W. (1997). Choice processing in emotionally
621 difficult decisions. *Journal of Experimental Psychology: Learning, Memory, and*
622 *Cognition, 23*(2), 384.

MacMahon, C., Mascarenhas, D. R. D., Plessner, H., Pizzera, A., Oudejans, R. R. D., & Raab, M. (2015). *Sports officials and officiating: Science and practice*. Abingdon, Oxon: Routledge.

Mallo, J., Frutos, P. G., Juárez, D., & Navarro, E. (2012). Effect of positioning on the accuracy of decision making of association football top-class referees and assistant referees during competitive matches. *Journal of Sports Sciences, 30*(13), 1437-1445. doi:10.1080/02640414.2012.711485

Marcelino, R., Mesquita, I., Palao, J., & Sampaio, J. (2009). Home advantage in high-level volleyball varies according to set number. *Journal of Sports Science and Medicine, 8*(3), 352-356.

Mascarenhas, D. R. D., Button, C., O'Hare, D., & Dicks, M. (2009). Physical performance and decision making in association football referees: A naturalistic study. *International Journal of Sport Psychology, 37*(2/3), 99.

Mascarenhas, D. R. D., O'Hare, D., & Plessner, H. (2006). The psychological and performance demands of association football refereeing. *International Journal of Sport Psychology, 37*(2/3), 99.

Masters, R. S. W. (1992). Knowledge, knerves and know how- the role of explicit versus implicit knowledge in the breakdown of complex motor skill under pressure. *British Journal of Psychology, 83*(3), 343-358.

Masters, R. S. W., & Maxwell, J., P. (2004). Implicit motor learning, reinvestment and movement disruption: What you don't know won't hurt you? In A. M. Williams, & N. J.

644 Hodges (Eds.), *Skill aquisition in sport: Research, theory, and practice* (Second ed., pp.
645 207). New York: Routledge.

646 Masters, R. S. W., Polman, R. C. J., & Hammond, N. V. (1993). 'Reinvestment': A
647 dimension of personality implicated in skill breakdown under pressure. *Personality and*
648 *Individual Differences, 14*(5), 655-666. doi:10.1016/0191-8869(93)90113-H

649 Morris, G., & O'Connor, D. (2016). Key attributes of expert NRL referees. *Journal of Sports*
650 *Sciences,* , 1-6.

651 Nevill, A. M., Balmer, N. J., & Williams, A. M. (2002). The influence of crowd noise and
652 experience upon refereeing decisions in football. *Psychology of Sport and Exercise, 3*(4),
653 261-272. doi:10.1016/S1469-0292(01)00033-4

654 Nevill, A. M., & Holder, R. L. (1999). Home advantage in sport. *Sports Medicine, 28*(4),
655 221-236. doi:10.2165/00007256-199928040-00001

656 Nevill, A. M., Hemingway, A., Greaves, R., Dallaway, A., & Devonport, T. J. (2016).
657 Inconsistency of decision-making, the achilles heel of referees. *Journal of Sports*
658 *Sciences,* , 1-5.

659 Nevill, A. M., Newell, S. M., & Gale, S. (1996). Factors associated with home advantage in
660 english and scottish soccer matches. *Journal of Sports Sciences, 14*(2), 181-186.
661 doi:10.1080/02640419608727700

662 Nibbeling, N., Oudejans, R. R., & Daanen, H. A. (2012). Effects of anxiety, a cognitive
663 secondary task, and expertise on gaze behavior and performance in a far aiming task.
664 *Psychology of Sport and Exercise, 13*(4), 427-435. doi:10.1123/jsep.30.4.450

665 Nieuwenhuys, A., Pijpers, J. R., Oudejans, R. R. D., & Bakker, F. C. (2008). The influence of
666 anxiety on visual attention in climbing. *Journal of Sport & Exercise Psychology, 30*(2),
667 171-185. doi:10.1123/jsep.30.2.171

668 Oudejans, R. R. D., Verheijen, R., Bakker, F. C., Gerrits, J. C., Steinbrückner, M., & Beek, P.
669 J. (2000). Errors in judging 'offside' in football. *Nature, 404*(6773), 33-33.
670 doi:10.1038/35003639

671 Oudejans, R. R. D., Bakker, F. C., Verheijen, R., Gerrits, J. C., Steinbruckner, M., & Beek, P.
672 J. (2005). How position and motion of expert assistant referees in soccer relate to the
673 quality of their offside judgements during actual match play. *International Journal of*
674 *Sport Psychology, 36*(1), 3-21. doi:1871/50780

675 Page, K., & Page, L. (2010). Alone against the crowd: Individual differences in referees
676 ability to cope under pressure. *Journal of Economic Psychology, 31*(2), 192-199.
677 doi:10.1016/j.joep.2009.08.007

678 Paget, N. (2015). *Performance analysis of high performance netball umpires for match-play*
679 *and fitness demands* (Doctoral dissertation, Auckland University of Technology).
680 doi:10292/8963

Paradis, K., Larkin, P., & O'Connor, D. (2015). The effects of physical exertion on decision-making performance of australian football umpires. *Journal of Sports Sciences, 34*(16), 1535-1541. doi:10.1080/02640414.2015.1122205

Plessner, H. (1999). Expectation biases in gymnastics judging. *Journal of Sport & Exercise Psychology, 21*(2), 131-144. doi:10.1123/jsep.21.2.131

Plessner, H., & MacMahon, C. (2013). The sports official in research and practice. In D. Farrow, J. Baker & C. MacMahon (Eds.), *Developing sport expertise: Researchers and coaches put theory into practice* (Second ed., pp. 71-131). New York: Routledge.

Pollard, R. (2008). Home advantage in football: A current review of an unsolved puzzle. *The Open Sports Sciences Journal, 1*(1), 12-14. doi:10.2174/1875399X00801010012

Poolton, J., Siu, C. M., & Masters, R. S. W. (2011). The home team advantage gives football referees something to ruminate about. *International Journal of Sports Science and Coaching, 6*(4), 545-552. doi:10.1260/1747-9541.6.4.545

Raab, M. (2012). Simple heuristics in sports. *International Review of Sport and Exercise Psychology, 5*(2), 104-120. doi:10.1080/1750984X.2012.654810

Renden, P. G., Landman, A., Geerts, S. F., Jansen, S. E. M., Faber, G. S., Savelsbergh, G. J. P., & Oudejans, R. R. D. (2014). Effects of anxiety on the execution of police arrest and self-defense skills. *Anxiety, Stress & Coping, 27*(1), 100-112. doi:10.1080/10615806.2013.810213

Roy, M. M., Memmert, D., Frees, A., Radzevick, J., Pretz, J., & Noel, B. (2016). Rumination and performance in dynamic, team sport. *Frontiers in Psychology, 6*, 2016. doi:10.3389/fpsyg.2015.02016

Schnyder, U., & Hossner, E. (2016). Decision making in football officiating: An interview study with top-level referees. *Research Quarterly for Exercise and Sport, 87*(S1), S81.

Scoppa, V. (2008). Are subjective evaluations biased by social factors or connections?: An econometric analysis of soccer referee decisions. *Empirical Economics, 35*(1), 123-140. doi:10.1007/s00181-007-0146-1

Souchon, N., Cabagno, G., Traclet, A., Dosseville, F., Livingstone, A. G., Jones, M. V., & Maio, G. R. (2010). Referees' decision-making and player gender: The moderating role of the type of situation. *Journal of Applied Sport Psychology, 22*(1), 1-16. doi:10.1080/10413200903250476

Souchon, N., Cabagno, G., Traclet, A., Trouilloud, D., & Maio, G. R. (2009). Referees' use of heuristics: The moderating impact of standard of competition. *Journal of Sports Sciences, 27*(7), 695-700.

Souchon, N., Livingstone, A. G., Bardin, B., Rascle, O., Cabagno, G., & Maio, G. R. (2016). Influence of competition level on referees' decision-making in handball. *Social Influence, ,* 1-13.

Stulp, G., Buunk, A. P., Verhulst, S., & Pollet, T. V. (2012). High and mighty: Height increases authority in professional refereeing. *Evolutionary Psychology : An*

International Journal of Evolutionary Approaches to Psychology and Behavior, 10(3), 588-601. doi:10.1177/147470491201000314

Sutter, M., & Kocher, M. G. (2004). Favoritism of agents - the case of referees' home bias. *Journal of Economic Psychology, 25*(4), 461-469. doi:10.1016/S0167-4870(03)00013-8

Trapnell, P. D., & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality: Distinguishing rumination and reflection. *Journal of Personality and Social Psychology, 76* (2), 284-304. doi: 10.1037/0022-3514.76.2.284

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive therapy and research, 27*(3), 247-259. doi: 10.1023/A:1023910315561

Terry, P. C., Walrond, N., & Carron, A. V. (1998). The influence of game location on athletes' psychological states. *Journal of Science and Medicine in Sport, 1*(1), 29-37. doi:10.1016/S1440-2440(98)80006-6

Unkelbach, C., & Memmert, D. (2010). Crowd noise as a cue in referee decisions contributes to the home advantage. *Journal of Sport and Exercise Psychology, 32*(4), 483-498.

Weston, M., Bird, S., Helsen, W., Nevill, A. M., & Castagna, C. (2006). The effect of match standard and referee experience on the objective and subjective match workload of english premier league referees. *Journal of Science and Medicine in Sport, 9*(3), 256-262. doi:10.1016/j.jsams.2006.03.022

739 Weston, M., Castagna, C., Impellizzeri, F. M., Bizzini, M., Williams, A. M., & Gregson, W.
740 (2012). Science and medicine applied to soccer refereeing. *Sports Medicine, 42*(7), 615-
741 631. doi:10.2165/11632360-000000000-00000

742