



Swansea University  
Prifysgol Abertawe



## Cronfa - Swansea University Open Access Repository

---

This is an author produced version of a paper published in:  
*International Journal of Sports Science & Coaching*

Cronfa URL for this paper:

<http://cronfa.swan.ac.uk/Record/cronfa29591>

---

### Paper:

Kennedy, M. & Knight, C. (2017). Bench behaviour of ice hockey coaches: Psychophysiological and verbal responses to critical game incidents. *International Journal of Sports Science & Coaching*, 12(3), 303-311.

<http://dx.doi.org/10.1177/1747954117710509>

---

This item is brought to you by Swansea University. Any person downloading material is agreeing to abide by the terms of the repository licence. Copies of full text items may be used or reproduced in any format or medium, without prior permission for personal research or study, educational or non-commercial purposes only. The copyright for any work remains with the original author unless otherwise specified. The full-text must not be sold in any format or medium without the formal permission of the copyright holder.

Permission for multiple reproductions should be obtained from the original author.

Authors are personally responsible for adhering to copyright and publisher restrictions when uploading content to the repository.

<http://www.swansea.ac.uk/iss/researchsupport/cronfa-support/>

1 **Article Type**

2 *Original research*

3

4 **Title**

5 Bench behaviour of ice hockey coaches: Psychophysiological and verbal responses to  
6 critical game incidents

7

8 Michael D Kennedy<sup>1</sup> and Camilla J Knight<sup>2</sup>

9 <sup>1</sup>Faculty of Physical Education and Recreation, University of Alberta, CANADA; <sup>2</sup>Applied  
10 Sport, Technology, Exercise, and Medicine Research Centre, Swansea University, Fabian  
11 Way, Swansea, UK

12 **Corresponding author:**

13 Michael David Kennedy, Faculty of Physical Education and Recreation, University of  
14 Alberta, 4-208 Van Vliet Centre, Edmonton, Alberta, T6G 2H9, CANADA.

15 Email: [kennedy@ualberta.ca](mailto:kennedy@ualberta.ca)

16

17

18

19

20 **Short Title**

21 Bench behaviour of ice hockey coaches

22

1 **Abstract**

2 The purpose of this study was to examine coaches' psychophysiological and verbal  
3 responses to different game situations. The in-game heart rate and verbal responses of 3  
4 elite ice hockey coaches to 4 critical game incidents (Goals For/Against; Penalties  
5 Taken/Drawn) over 4 University Women's games were assessed. Verbal comments were  
6 categorised using the Coach Behaviour Assessment System, and then comments and heart  
7 rate were sequenced to critical incidents recorded on video review. Overall, in-game heart  
8 rate was greater than rest and coaches were rarely silent. General encouragement and  
9 general commentary were the most common verbal comments. Two hundred and eight  
10 critical incident comments were recorded (Goals For/Against 34.6 %; Penalties  
11 Taken/Drawn 65.4%) associated with a 10 bpm greater heart rate. Most common verbal  
12 responses to critical incidents were general commentary, silence, and organisation. The  
13 type of comment was affected by the type of critical incident. In 78 % of critical incidents  
14 the type of comment made before incidents differed to type of comment after the incident,  
15 coaches rarely talked at the same time and silence was common. These novel findings are  
16 limited to ice hockey coaches given the small sample size. However these results should  
17 encourage more research into the psychophysiological and verbal responses of coaches in  
18 other team sports real game situations to better understand in game coaching behaviour.

1 **Keywords**

2 Coach behaviours, psychophysiological, game criticality, coach education

3 **Introduction**

4 Coaching behaviour has been systematically studied using direct observation and  
5 other analytical methods providing great insight into the actions and motivations of  
6 coaches.<sup>1,2</sup> This body of knowledge has shown that instruction is a key aspect of coaching  
7 and that overall the types of behaviours coaches display are consistent across age and skill  
8 level.<sup>3</sup> However, most of our knowledge of coach behaviours has been obtained in practice  
9 settings rather than games or competitions due to greater frequency of practices (compared  
10 to games) and willingness of coaches to be observed.<sup>2</sup> Unfortunately, practice behaviours  
11 do not translate to competition behaviours<sup>4</sup> and game coaching behaviour has been  
12 identified as an important aspect of a coach's overall performance strategy.<sup>5</sup> Thus,  
13 increasing our knowledge of coaches' in-game behaviours seems pertinent. As Partington  
14 and Cushion<sup>1</sup> explained, having a richer understanding of coaches' behaviour during  
15 competition is a necessary step to initiate greater change in general coaching practices.

16 The few studies that have examined coaching behaviour during games have used a  
17 variety of quantitative (observation to determine behavioural categories), qualitative  
18 (interviews), and mixed methods approaches to obtain data.<sup>2</sup> A synopsis of observational  
19 research identifies spontaneous and reactive behaviours, associated with performance

1 development, encouragement, and purposeful silence.<sup>2,4,6</sup> Despite silence being identified as  
2 one key coaching behaviour, the majority of behaviours are associated with some verbal  
3 attribute. Accordingly, some researchers have specifically examined the verbal behaviour  
4 (comments) of coaches during games.<sup>6,7</sup> Such studies have identified the positive effect  
5 coaches' verbal comments can have on athletes' motivation and performance. For example,  
6 athletes have indicated that in high pressure situations verbal comments that are 'direct and  
7 to the point,' as well as not sounding nervous or emotional have a calming effect<sup>8</sup> or  
8 improve focus.<sup>9</sup> Some factors influencing coaches' comments during competitions have  
9 also been identified. For example, it has been suggested that verbal comments of coaches  
10 are influenced by the importance of that sport to National pride,<sup>7</sup> as well as the team's  
11 league standing, the time in the season, and within game morale.<sup>6</sup> However, what is not  
12 well understood is the influence situation criticality and specific incidents within a game  
13 have on coaches' verbal behaviours. Situation criticality, which has been defined as the  
14 perceived importance assigned to a competitive situation,<sup>10</sup> has been recognised as an  
15 important variable that can affect emotional and behavioural reactions in sport. Given the  
16 pressures that coaches can experience during competitions,<sup>11</sup> it is feasible to assume  
17 coaches' behaviours and emotions will also be affected by different incidents and critical  
18 situations as they occur during games.

1           Although research has yet to examine coaches' verbal reactions to different critical  
2 incidents, some insights have been gained into the impact of competition and situation  
3 criticality on coaches' psychophysiological stress (measured through changes in heart rate  
4 (HR)).<sup>12</sup> Psychophysiological stress is defined as increased psychological and physiological  
5 arousal caused by a reaction to perceived threats and demands, and HR has been used to  
6 measure this because it is a tightly controlled index of arousal.<sup>13</sup> McCafferty, Gliner, and  
7 Hovath<sup>14</sup> examined the HR response of coaches working in various sports, such as  
8 swimming, water polo, and volleyball, and identified an increase in HR in response to  
9 competition. In addition, it has been found that coaches' HR responds to specific features of  
10 competition such as type and importance of contest.<sup>14,15</sup> Together these studies provide  
11 consistent evidence that coach's experience average HR during games/competitions is  
12 greater and certain aspects of a competition may accelerate the HR response from baseline  
13 game HR.

14           However, to date, the simultaneous analysis of psychophysiological and verbal  
15 comments to specific critical incidents in a competitive setting have not been determined.  
16 Thus, the purpose of the current study was to examine high performance coaches'  
17 psychophysiological and verbal responses to competition and different game situations.  
18 Specifically, the study sought to examine: (a) Ice hockey coaches' HR response and verbal

1 comments to a competitive game, and (b) whether critical game incidents were associated  
2 with a change in HR and specific types of verbal comments. We hypothesised that HR  
3 would vary over the course of a game and would increase in response to critical incidents  
4 witnessed by the coaches and decrease after the critical incident. We also hypothesised that  
5 critical incidents would cause a change in verbal comments from the coach and that the  
6 type of verbal comment would change depending on the type of critical incident occurring.

## 7 **Methods**

### 8 *Participants*

9 One Head Coach (HC) and two Assistant Coaches (AC) of a Canadian university  
10 women's hockey team participated in the study. The university league is the most  
11 competitive amateur ice hockey league in Canada and is the main women's elite  
12 developmental league for Hockey Canada. The HC was a 46-year-old male who had been a  
13 full-time professional HC for the current university team for 12 years, with 16 years of total  
14 experience as a coach. The part time AC's were a male coach aged 44 years (AC 1) and a  
15 female (AC 2) aged 49 years. Both AC's were high level hockey coaches with diverse  
16 playing and coaching experiences.

### 17 *Data Collection*

18 The study received institutional research ethics board approval and written informed  
19 consent was obtained from all participants before initiating data collection. Data collection

1 occurred at four regular season home games. Verbal comments, HR, and critical game  
2 incidents for each game were collected as outlined below.

3 *Critical Incidents.* For the purpose of this study, the four most important critical  
4 incidents to a game outcome (goals for and against, and penalties taken and drawn) as  
5 indicated were examined. Initially, two researchers recorded the critical incidents while  
6 watching the games live. A third researcher confirmed the timings and details of the critical  
7 incidents by reviewing video recordings of the games.

8 *HR.* Pre-game HR (30 minutes immediately prior) and game HR response was  
9 measured continuously with Suunto T6 heart monitors set to record and store HR data  
10 every 10 seconds with subsequent download and analysis using Sunnto Team Analysis  
11 software. For determination of the HR associated with a critical incident the HR  
12 corresponding to the time point at which the incident occurred was determined. In addition,  
13 the HR immediately preceding and immediately after the critical incident were also used to  
14 come up with a 30 second average HR for each critical incident. This conservative  
15 approach was taken to ensure that the critical incident was truly captured within that HR  
16 time frame and to reduce any HR artefact due to a sudden movement or breath hold, both of  
17 which affect cardio-acceleration of HR. To determine % of HR max the coaches were



1 working at, the age predictive HR Max equation  $205.8-0.685(\text{age})^{16}$  was used, where  
2 overall mean period HR was divided by their predicted maximum HR.

3 *Verbal comments.* A lapel-microphone connected to audio-recorders was attached to  
4 each coach's jacket. All the comments each coach made from the warm-up to the end of the  
5 game were recorded. Audio-comments made during the game were transcribed verbatim  
6 and the time each comment was made was recorded. Each comment was then coded against  
7 the categories outlined in the Coach Behaviour Assessment System (CBAS).<sup>17</sup> To ensure  
8 the comments were coded in context the coding took place while listening to recordings of  
9 comments and watching game video. Comments were coded in the following categories:  
10 General communication, organisation, general encouragement, general tactical instruction,  
11 mistake-contingent tactical instruction, mistake-contingent encouragement, and criticism.<sup>17</sup>  
12 Additional categories of general commentary and communication with the referee were  
13 also used. Once the data had been coded against the CBAS, a selection of the coded  
14 comments was shared with another researcher who confirmed the allocation of data within  
15 the categories.

#### 16 *Data Analysis*

17 *Data matching.* Once all the comments had been coded, the HR data downloaded,  
18 and the critical incidents recorded, each set of data was then matched by time. Once the  
19 data had been matched by time one researcher re-watched all the recordings of each game

1 while listening to the audio recordings and reviewing the time matched data to ensure  
2 accuracy. Two researchers then reviewed the time-matched data, looked at each critical  
3 incident, and reviewed the HR responses and verbal comments to verify accuracy of  
4 matching. Any potential errors (e.g., comments that did not appear to match the incident)  
5 were rechecked against the raw data.

6 *Statistics.* Full descriptive statistics was completed using SPSS V 22.0. HR data was  
7 analysed using repeated measures ANOVA with a level of significance set a priori at  $p <$   
8 0.05. Verbal comments were assessed using cross-tabulation with categorical variables of  
9 coach, period, type of critical incident, and timing of comment (pre or post) used where  
10 appropriate to elucidate the verbal comments patterns. The verbal comment comparisons  
11 are provided in greater details in the results both for overall frequencies (regardless of  
12 critical incident) and also in regard to the critical incident assessed.

### 13 **Results**

#### 14 *Overall HR response*

15 The overall HR responses are presented in Table 1. The mean period HR expressed  
16 as a percentage of HR max was 63, 48, and 45 % respectively for HC, AC1, and AC2.

17 \*\*\*\*\*Table 1 here\*\*\*\*\*







1 The HC and AC1 were silent the most (23.6 and 31 %) and AC2 most often provided  
2 general commentary (27.8 %) around critical game incidents. Other comments from the HC  
3 include mistake contingent tactical instruction (19.5 %) and general commentary (16.1 %)  
4 before the incident, and organisation and general encouragement after. AC1 provided  
5 general commentary (21.4 %) prior to a critical incident, and general encouragement (26.2  
6 %) after a critical incident. AC2 was the least silent, and provided general commentary both  
7 before and after incidents (34.2 and 21.5 % respectively), as well as reinforcement (16.5 %)  
8 before and organisation (22.8 %) after.

9 In 45 instances the type of comment made before and after the critical incident was  
10 the same and the pattern that was most common was silence (14 instances), general  
11 commentary (10 instances), organisation (8 instances), with mistake contingent tactical  
12 instruction, general tactical instruction, general encouragement, general communication,  
13 and reinforcement also identified with this pattern. Silence and general commentary  
14 accounted for 63 % of all same type comments associated with Goals For and Against.  
15 Silence and general commentary was also common for Penalties Drawn (69 %) and in  
16 Penalties Taken 46 % of same type comments were identified as organisation.



1           More importantly we wanted to understand if psychophysiological strain measured  
2 as HR was sensitive to emotional critical incidents<sup>21</sup> that have a major influence on the  
3 outcome of the game. Cardioacceleration of HR (rapid increase in HR) was evident in  
4 many instances associated with one of the four key critical incidents graphically illustrated  
5 in Figure 1 for each coach in a representative game. Others have found unequivocal  
6 psychophysiological responses of coaches to winning or losing game contexts.<sup>12</sup> Thus there  
7 may be an implication that the type of critical incident is important to evoking a  
8 psychophysiological response.

9           Figure 1 also illustrates that coaches do have psychophysiological arousal induced  
10 HR response during a competitive game. This conclusion can be made because the activity  
11 level was very low (the coaches stood or paced very slowly) for the duration of the games.  
12 Thus HR is greater than what would be expected given the level of activity the coaches  
13 made during the games. Additionally, the rate of increase (magnitude /given period of time)  
14 in these coaches to a critical incident followed the classic ‘exercise onset  
15 cardioacceleration’ pattern of rapid increase to peak at 10s followed by transient drop in  
16 HR within 20 seconds, illustrating significant autonomic nervous system involvement.<sup>22</sup>  
17 Thus, the HR variation in our study is likely psychophysiological, where the assessment of



1 a situation evokes both a behaviour and a physiological response (HR) of coaches in game  
2 situations.<sup>21</sup>

3 *Verbal response to game play*

4 With regards to the verbal comments coaches' made during the games, there appear  
5 to be some inconsistencies with previous research, particularly with regards to the amount  
6 of comments the coaches' made. Although few studies have examined coaches' verbal  
7 comments during competitions, the findings from those that have generally conclude that  
8 coaches spend a considerable proportion of their time making no comments.<sup>2,7</sup> However, in  
9 the current study, the coaches, particularly the AC's were rarely silent. Instead the AC's  
10 spent much of their time either organising the team (i.e, telling different lines to get ready  
11 and go onto the ice) or providing a general commentary of the game. This general  
12 commentary was not directed at any players and did not appear to fulfil any specific  
13 coaching need (that is it contained no instruction, reinforcement, or encouragement). Two  
14 potential explanations for such an extensive commentary are that it allowed the coaches to  
15 remain engaged with the game and was also used as a strategy to help coaches' manage  
16 their own emotions, although this is clearly speculative.

17 Overall, compared to the AC's, the HC did spend more time standing silently  
18 watching the game, particularly leading up to and following certain goals and penalties.  
19 Given the HC's large HR response to critical incidents, it is perhaps surprising that such

1 behaviours were evident. In line with previous suggestions (cf.,<sup>23</sup>), it appeared that such  
2 silence was purposeful and perhaps adopted to provide the players with an opportunity to  
3 process and assess the situation themselves, before being provided with instruction.<sup>2</sup>

4         With regards to the coaches' verbal reactions to specific critical incidents two  
5 patterns emerged; the same type of comment was made before and after the incident, or  
6 different types of comments were made pre and post-incident. Overall, only 22 % (45 of  
7 208 instances) of all critical incidents had the 'same type' before and after critical incident,  
8 and of those 45 instances silence-silence accounted for 33% of all pairs. Of those silence-  
9 silence pairs Penalty Drawn and Goals Against were the most prevalent incidents that were  
10 met with silence. In these instances, silence seemed to be a behavioural choice from the  
11 coach, either to allow other coaches to verbally communicate with players or to allow  
12 players to consider the situation themselves.

13         Organisation-organisation comments before and after critical incidents were also  
14 common and was associated with penalties taken (8 of 10 instances). Furthermore, within  
15 'non-same' type comments there were 12 additional instances that coaches provided  
16 organisation type comments after a Penalty Taken, but only one coach provided  
17 organisation advice. Although it is well known that a 'penalty kill' is an important aspect of

1 ice hockey and is practiced extensively,<sup>24</sup> this study highlights the frequency of ‘in game’  
2 organisation comments from coaches to elite ice hockey players.

3           It is worth noting that, regardless of the specific incident or the time in the game,  
4 the coaches were rarely critical of the players; almost all their comments were instructive,  
5 encouraging, or reinforcing good play. Such findings indicate that coaches coaching at the  
6 collegiate level differ from coaches of children where the majority of verbal comments  
7 (when made) were categorised as neutral or negative, with only 35.4% of comments being  
8 positive.<sup>7</sup> This may simply be indicative of the coaching philosophies of the three coaches  
9 or the programme in which these coaches work, but might also be a demonstration of the  
10 control these coaches have over their emotions and awareness of the comments they are  
11 making. Interestingly, Walters et al.<sup>7</sup> identified that sports with high national significance  
12 may expect their coaches to be more competent (and successful), placing more pressure on  
13 coaches and provoking controlling behaviours. In this project, we have studied a sport that  
14 has great national significance but, similar to others who have studied ice hockey in  
15 Canada,<sup>4</sup> such cultural pressure did not seem to provoke significant negative comments.

16           When comparing the results of this study to other research examining coaching  
17 behaviour in ice hockey games, there appears to be quite substantial differences. Trudel et  
18 al.<sup>4</sup> observed the behaviours of 14 coaches during elite youth hockey games. Trudel et al.<sup>4</sup>

1 identified that the majority of the coaches' time was spent observing the game, and, when  
2 coaches did interact with players the most frequent behaviours were organisation and  
3 directing the game. In contrast to the findings of the current study where mistake-  
4 contingent tactical instruction and general tactical instruction accounted for 24% of all  
5 comments, the coaches in Trudel et al.<sup>4</sup> and colleagues study provided limited instruction to  
6 their players. Trudel et al.<sup>4</sup> offered that the low amount of feedback observed in their study  
7 demonstrated that coaches were not utilising teachable moments during games. In the  
8 present study, the coaches appeared to use games as opportunities to teach their players in  
9 context.

#### 10 *Limitations*

11 This study focused upon four critical incidents. However, other critical incidents  
12 such as errant shots or poor passes could provide greater insight into the coaching  
13 behaviours of ice hockey coaches. Additionally, given the continual nature of ice hockey  
14 games, it is possible that coaches were reacting to more than one critical incident at a time  
15 or were commenting on incidents that coincided with incidents that were coded by the  
16 research team.

#### 17 **Conclusion**

18 In summary, these ice hockey coaches experienced cardioacceleration of HR was  
19 associated with critical incidents, a finding which brings greater insight to the physiological

1 response of coaches to game criticality. The coaches also consistently talked throughout  
2 each game and the majority of their comments were general commentary and positive in  
3 nature. Critical incidents were associated with a change in the type of comment made,  
4 although coaches were also silent in response to critical incidents. This enforces the idea  
5 that these coaches in ice hockey are judicious in their use of comments at times of critical  
6 game incidents. Furthermore the type of critical incident caused specific patterns in type of  
7 verbal comment such as penalties taken associated with organisation type comments. In  
8 combination our data identifies that ice hockey coaches seem able to control the types of  
9 comments they made during games, despite the psychophysiological response that occurs to  
10 the critical instances studied. These results are not immediately generalizable to other team  
11 sports coaching behaviours however these preliminary findings in ice hockey do provide  
12 novel insight to in-game coaching behaviour. Thus despite the small sample size these  
13 results are sufficient to encourage further research of in-game coaching behaviours and  
14 psychophysiological responses during ice hockey and other continuous time sports such as  
15 basketball, soccer, handball, field hockey, ultimate, and rugby.

16

17

18

19

1 **Funding:**

2 This work was supported by a grant from the Sport Science Association of Alberta.

3 Neither author has benefited personally or financially from the application of this research.

4 **Declaration of Conflicting Interests:**

5 The author(s) declared no potential conflicts of interest with respect to the research,

6 authorship, and/or publication of this article.

7

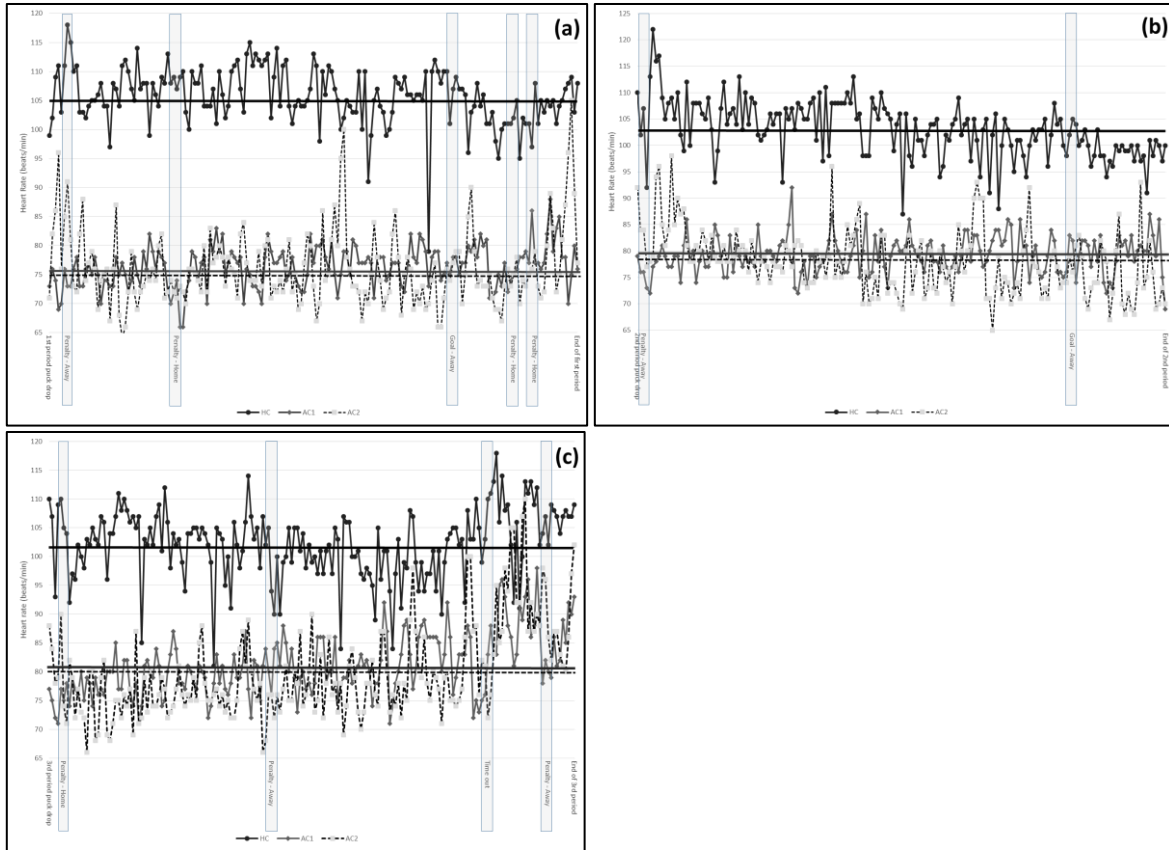
1 **References**

- 2 1. Partington M, Cushion C. An investigation of the practice activities and coaching behaviors of  
3 professional top-level youth soccer coaches. *Scand J Med Sci Sports* 2013; 23(3): 374-382.
- 4 2. Smith M, Cushion CJ. An investigation of the in-game behaviours of professional, top-level youth  
5 soccer coaches. *J Sports Sci* 2006; 24(4): 355-366.
- 6 3. Ford PR, Yates I, Williams AM. An analysis of practice activities and instructional behaviours  
7 used by youth soccer coaches during practice: Exploring the link between science and application.  
8 *J Sports Sci* 2010; 28(5): 483-495.
- 9 4. Trudel P, Côté J, Bernard D. Systematic observation of youth ice hockey coaches during games. *J*  
10 *Sport Behav* 1996; 19(1): 50.
- 11 5. Lyle J. *Sports coaching concepts: A framework for coaches' behaviour*. Psychology Press, 2002.
- 12 6. Moreno M, Santos J, Ramos L, Cervelló E, Iglesias D, Del Villar F. The efficacy of the verbal  
13 behaviour of volleyball coaches during competition. *European Journal of Human Movement* 2010;  
14 3: 55-69.
- 15 7. Walters SR, Schluter PJ, Oldham AR, Thomson RW, Payne D. The sideline behaviour of coaches  
16 at children's team sports games. *Psychol Sport Exerc* 2012; 13(2): 208-215.
- 17 8. Becker AJ. It's not what they do, it's how they do it: Athlete experiences of great coaching.  
18 *International Journal of Sports Science & Coaching* 2009; 4(1): 93-119.
- 19 9. Palmer ME. *The direct impact of team cohesiveness and athletes' perception of coaching*  
20 *leadership functions on team success in NCAA division I women's basketball*. PhD Thesis, Texas  
21 Woman's University, USA, 2013.
- 22 10. Vallance JK, Dunn JG, Dunn JLC. Perfectionism, anger, and situation criticality in competitive  
23 youth ice hockey. *Journal of Sport and Exercise Psychology* 2006; 28(3): 383.
- 24 11. Frey MA. *Collegiate coaches' experiences with stress- 'Problem-solvers' have problems, too*. PhD  
25 Thesis, The University of Tennessee, USA, 2004.

- 1 12. Mowat TJ. *Arousal and behaviour of coaches during competition*. Victoria University of  
2 Technology, USA, 2004.
- 3 13. Sharpley CF. Heart rate reactivity and variability as psychophysiological links between stress,  
4 anxiety, depression, and cardiovascular disease: Implications for health psychology interventions.  
5 *Australian Psychologist* 2002; 37(1): 56-62.
- 6 14. McCafferty WB, Gliner JA, Horvath S. The stress of coaching. *The Physician and Sportsmedicine*  
7 1978; 6:2: 66-71.
- 8 15. Teipel D. Analysis of stress in soccer coaches. *Science and Football II* 1993: 445-449.
- 9 16. Inbar O, Oren A, Scheinowitz M, Rotstein A, Dlin R, Casaburi R. Normal cardiopulmonary  
10 responses during incremental exercise in 20- to 70-yr-old men. *Med Sci Sports Exerc* 1994; 26(5):  
11 538-546.
- 12 17. Smith RE, Smoll FL, Hunt E. A system for the behavioral assessment of athletic coaches.  
13 *Research Quarterly. American Alliance for Health, Physical Education and Recreation* 1977; 48(2):  
14 401-407.
- 15 18. Delashmit SJ. *The effects of game stress situations on the heart rates of selected high school*  
16 *football coaches*. PhD Thesis, University of Oregon, USA, 1992.
- 17 19. Porter DT, Allsen PE. Heart rates of basketball coaches. *The Physician and Sport Medicine* 1978;  
18 67: 85-90.
- 19 20. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, et al. American college  
20 of sports medicine position stand. quantity and quality of exercise for developing and maintaining  
21 cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance  
22 for prescribing exercise. *Med Sci Sports Exerc* 2011 Jul; 43(7): 1334-1359.
- 23 21. Hudson J, Davison G, Robinson P. Psychophysiological and stress responses to competition in  
24 team sport coaches: An exploratory study. *Scand J Med Sci Sports* 2013; 23(5): e279-e285.
- 25 22. Fagraeus L, Linnarsson D. Autonomic origin of heart rate fluctuations at the onset of muscular  
26 exercise. *J Appl Physiol* 1976; 40(5): 679-682.



- 1 23. Mouchet A, Harvey S, Light R. A study on in-match rugby coaches' communications with  
2 players: A holistic approach. *Physical Education and Sport Pedagogy* 2014; 19(3): 320-336.
- 3 24. Lee M. The use of video feedback as a performance analysis coaching tool in amateur level ice  
4 hockey. Bachelor's Thesis, Haaga-Helia University of Applied Sciences, Finland, 2011.
- 5

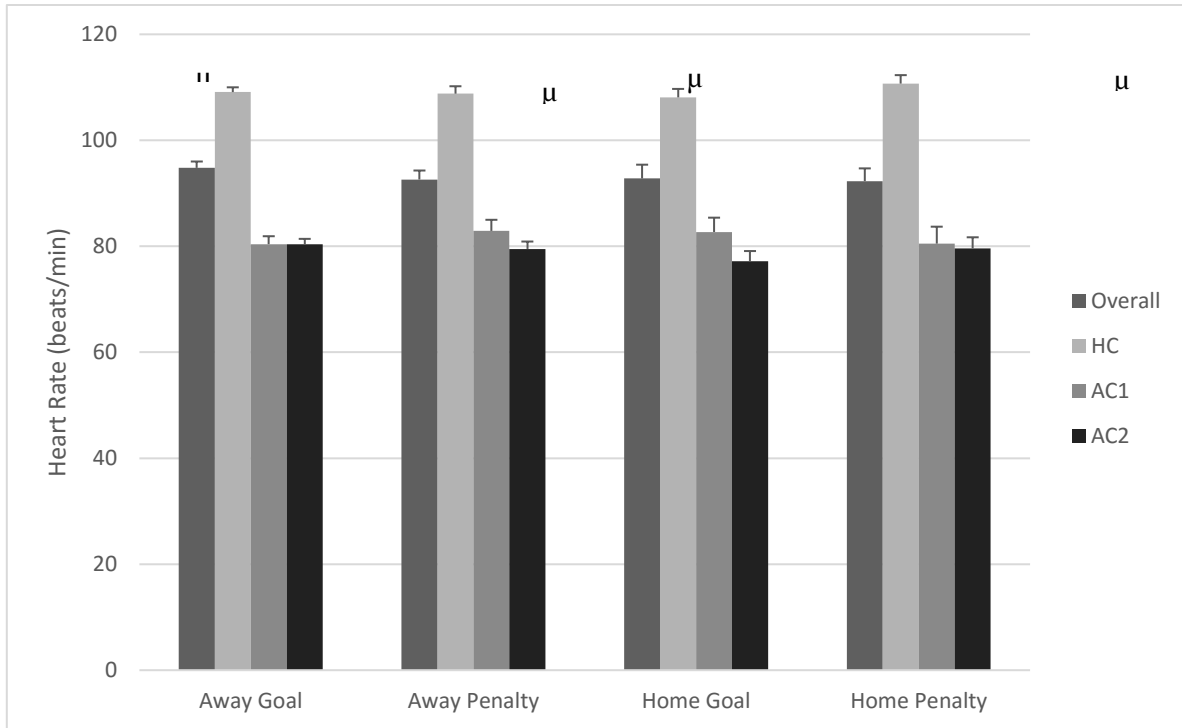


1

2

3 **Figure 1.** Ten second averaged heart rate (HR) response measured in beats per minute for  
 4 each coach (see legend for identification of each coach) where Panel (a), (b), (c) are Periods  
 5 1, 2 and 3 respectively. Critical incidents are highlighted by rectangular boxes and mean  
 6 HR response for each coach for each period is shown as the horizontal line bisecting the  
 7 HR response line.

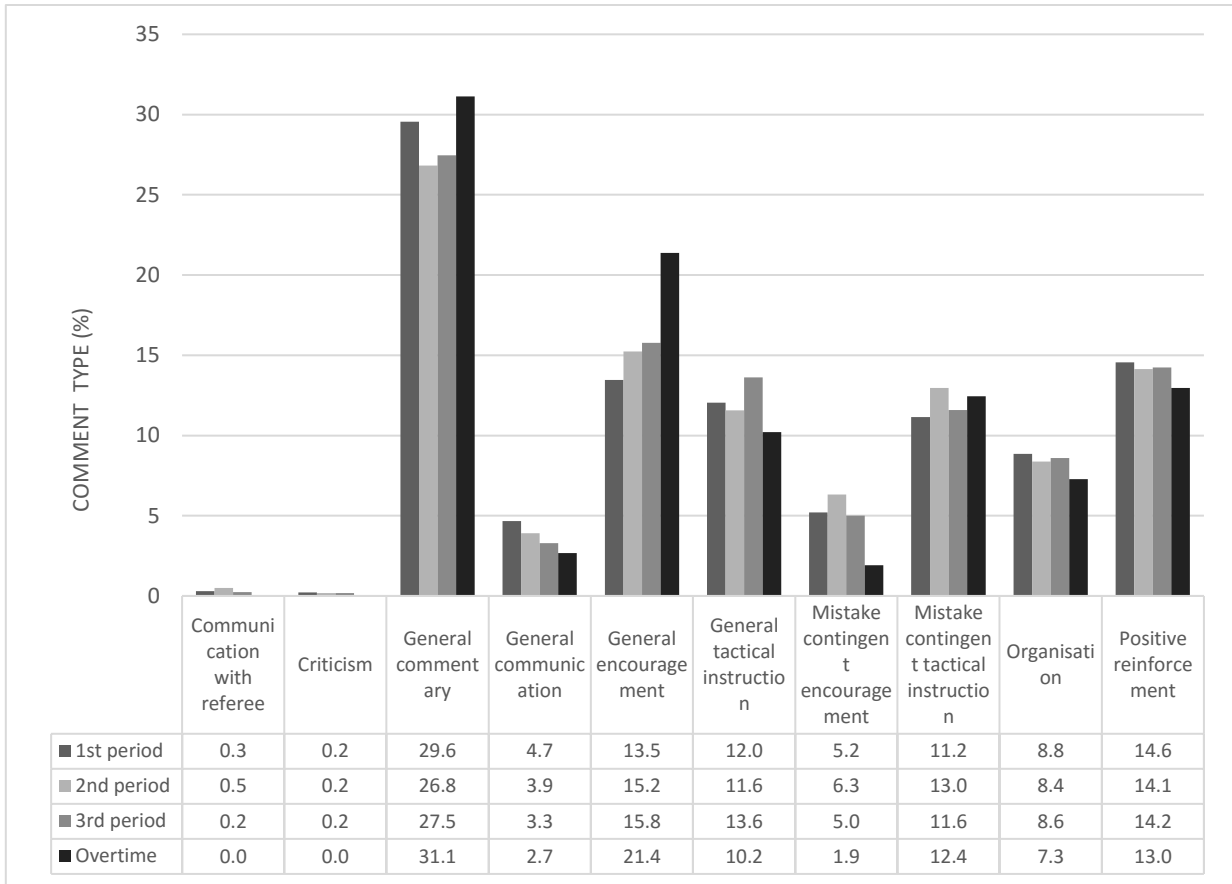
8



1

2 **Figure 2.** Mean heart rate  $\pm$  SD response measures in beats per minute for each critical  
 3 incident overall (coaches combined) and individual response for each coach for ‘Goals For’  
 4 and ‘Goals Away’ as well as ‘Penalties Taken’ and ‘Penalties Drawn’.  $\mu$  indicates a  
 5 significant difference between the HC and AC 1 and AC 2 for each of the critical incident.

6



1

2 **Figure 3.** Coded comment of all coaches combined expressed as percent of comments

3 made by period and during overtime.

4

1 **Table 1.** The overall mean heart rate  $\pm$  SD expressed in beats / minute for the pre-game  
 2 period of 30 minutes immediately prior to the game and each period of play (all 4 games  
 3 combined).

	<b>Pre Game</b>	<b>1<sup>st</sup> Period</b>	<b>2<sup>nd</sup> Period</b>	<b>3<sup>rd</sup> Period<sup>4</sup></b>
<b>HC</b>	101.4 $\pm$ 6.3	111.6 $\pm$ 0.26	108.1 $\pm$ 0.20	108.0 $\pm$ 0.19 <sub>5</sub> 6
<b>AC1</b>	75.4 $\pm$ 7.6	83.3 $\pm$ 0.17	82.0 $\pm$ 0.21	81.4 $\pm$ 0.28 <sub>7</sub>
<b>AC2</b>	74.6 $\pm$ 8.4	77.2 $\pm$ 0.37	79.2 $\pm$ 0.37	81.3 $\pm$ 0.44 <sub>8</sub>

9  
 10  
 11  
 12  
 13  
 14  
 15  
 16  
 17  
 18  
 19

1 **Table 2.** Type of coded comment associated with critical incidents both before and after the  
 2 critical incident occurred. Values are expressed as percentage comment type for each  
 3 critical incident. Where no comment was associated with any critical incident in the before  
 4 analysis or after analysis the row is greyed out (communication with referee before and  
 5 criticism after are the two instances where this occurred).

Comment Category	Goal Against Before	Goal For Before	Penalty Drawn Before	Penalty Taken Before	Goal Against After	Goal For After	Penalty Drawn After	Penalty Taken After
Communication with referee					0.0	0.0	1.6	0.0
Criticism	0.0	0.0	1.6	0.0				
General commentary	24.4	25.8	20.6	26.0	17.1	9.7	14.3	11.0
General communication	2.4	3.2	4.8	6.8	2.4	0.0	4.8	9.6
General encouragement	9.8	12.9	11.1	2.7	17.1	19.4	22.2	9.6
General tactical encouragement	0.0	0.0	0.0	1.4	2.4	0.0	0.0	0.0
General tactical instruction	2.4	9.7	3.2	5.5	4.9	0.0	12.7	4.1
Mistake contingent encouragement	0.0	3.2	1.6	0.0	4.9	0.0	1.6	1.4
Mistake contingent tactical instruction	14.6	12.9	11.1	8.2	12.2	3.2	4.8	8.2
Organisation	7.3	0.0	6.3	13.7	9.8	0.0	11.1	35.6
Reinforcement	9.8	12.9	6.3	8.2	0.0	41.9	9.5	9.6
Silence	29.3	19.4	33.3	27.4	29.3	25.8	17.5	11.0

6

- 1 **Table 3.** Summary of comment pairs (before and after) where the after critical incident  
 2 comment differs from the before critical incident. Values expressed as frequency of times  
 3 each of comment pair was recorded across the 4 games analysed.

<b>Before incident comment type</b>	<b>After incident comment type</b>	<b>Frequency of occurrence</b>
Silence	General encouragement	10
	Organisation	10
	General commentary	9
	Reinforcement	8
General commentary	General communication	9
	Organisation	7
	Reinforcement	7
	General encouragement	4
General encouragement		
General communication		
Mistake contingent tactical instruction	Organisation	5
	General commentary	
	General encouragement	
	General tactical instruction	
	Reinforcement	2
Reinforcement	Silence	2
	Organisation	4
	Silence	4
Organisation	General encouragement	2
	General tactical instruction	2
	Mistake contingent tactical instruction	2
	Silence	2
	General communication	1

4