TIME-MOTION ANALYSIS OF ICE-HOCKEY SKILLS DURING GAMES

Dany Lafontaine, Mario Lamontagne, Kelly Lockwood,
University of Ottawa, Ottawa, Ontario, Canada

INTRODUCTION: As the body of knowledge specific to ice hockey skating has evolved, it still has to be determined how frequently those players perform certain skating skills over the course of a complete game. Such information can be quite useful for the development of training, technique, strategy and skate design. Time-motion analysis (TMA) is a method that has been used in the past by researchers on various sports (Ali & Farrally, 1991; Clayton, 1993; Docherty, Wenger & Neary, 1988; Mayhew & Wenger, 1985) to estimate the physiological costs as well as the skill frequencies. Studies of this type have been performed for ice-hockey (Green et al., 1976; Bracko, 1992), while never establishing the effects of position or playing level on the frequencies of the observed skills. Bracko (1992) did a TMA study on professional ice hockey that assessed the proportion of time spent performing various skills and compared the performance of high and low point scorers over the second period of two regular season games. One of the goals of that study was to develop a method to discriminate between high and low point scorers based upon skating characteristics. The number of players involved in that study was a total of twelve, limiting the impact of the conclusions that were drawn. Green et al. (1976) limited their interest to physiological parameters that might have influenced players' performance on the ice. Two levels of playing position were taken into consideration for the Green study, with playing time for defence and forward players being compared. With this study as well, there is a limiting factor in the number of players that took part in the study, with a total number of eight.
The purpose of the current study is therefore to measure the skating skills frequency performed by players at different playing positions (6) and playing level (2). It is expected that playing position and playing level will have an influence on the frequencies at which skills are performed.

METHODS: Players of two hockey teams, one Major Junior level team and one University level team, consented to participate in this study, and allowed the recording of five of their home games. The games were recorded by six video cameras simultaneously, to allow tracking of each player position independently. The players were followed by the cameras from the moment that they stepped onto the playing surface to the instant when they returned to the bench. When player changes occurred, the cameraperson began to film immediately the player that just stepped onto the ice. Play condition changes were monitored by having the cameraperson mentioned the changes into the microphone as well the cameras were zoomed out to allow counting players on the ice for face-offs. During penalties to the home team, the camera assigned to track that player position was turned off to facilitate analysis. Announcements made by the official game announcer were also helpful in following play condition. The videotapes were coded according to a codification system developed for this study. The skating skills definition were obtained from Bracko (1992) for the forwards and defences,

and Tretiak (1992) and Giguère & Pelchat (1988) for the goaltenders. Average frequencies of occurrence were calculated for all skills for all positions over the five games for each level. An analysis of variance (ANOVA) was performed on these data to compare the results according to play position, play condition and playing level. A Post-Hoc Tukey procedure was run to determine where differences existed, when they were found to be statistically significant (α=0.05).

RESULTS: The results obtained showed that there was no significant difference between the two playing levels under investigation. In fact, the correlation of skating skills between the Major Junior and University was very high between all positions.

The statistical analysis (ANOVA) showed that the position played had a statistically significant effect on the frequencies at which only one skill was performed. The Tukey Post Hoc procedure revealed that the difference was found between the *left defence* and the *center* positions for the backward skill skating.

The most significant factor was playing condition for all positions, including goaltender. This factor was found to have a significant effect on the frequencies at which all skills were performed. The differences between the different play conditions were statistically significant as well as for some skills. For example, the frequencies of all skills reported during the *even strength* play condition were found to significantly differ from the frequencies obtained during the other play conditions. Furthermore, the frequency at which the skill skating forward was observed significantly varied between the conditions *power play* and *power play with puck* as well as *power play* and *penalty killing*.

Playing condition was not tabulated in the same manner for the goaltenders. All skills were not statistically influenced by changes in play condition. The average frequency for the skill skating backward however, was statistically different for the conditions *even strength* and *penalty killing*. Significant differences were also found between *even strength and power play* as well as *even strength* and *penalty killing* for the skills short shuffle left, short shuffle right and ready position.

The number of factors investigated was reduced by grouping the skills regardless of play condition to establish a picture of an entire game while some skills were grouped together to diminish specificity of the skills. The turning skills were grouped together according to turn direction (i.e. sharp turn and cross-cut turn left and right), and the pivoting skills (i.e. back to front and front to back pivot) were grouped regardless of direction of the pivot (Table 1). A two-way ANOVA was run on the grouped data, to measure the differences between playing level and playing position. Again, no differences were found between playing levels. However, differences were found between positions with the grouped skills. For example, both defence players were found skating backward more often than all forwards, as well the left defence player skated backward more often than the right defence player. The left defence player was also found to glide backward more often than the players of all the other positions, while centres had a significantly lower average frequency for that skill than all the other positions as well. Consequently, both defence players were found to perform more pivots than all players at the forward positions did. The forward players however gave more body-checks than did both defence players. The left defence players stopped less often than the right defence players and less often than the right wing players as well.

Table 1. Average frequencies of grouped skating skills (SD) regardless of playing condition and playing level

Pos. /Skill	1	2	3	4	5	6	7	8	9	10	11	12	13
LD	100	353	776	406	518	141	130	34	32	34	64	491	345
	(57)	(10)	(74)	(11)	(12)	(14)	(11)	(4)	(3)	(1)	(2)	(32)	(22)
RD	765	284	445	167	531	143	265	55	41	58	49	300	239
	(31)	(10)	(42)	(8)	(42)	(6)	(13)	(11)	(2)	(9)	(8)	(50)	(30)
RW	694	40	629	109	150	132	193	68	75	39	28	268	226
	(146)	(2)	(107)	(5)	(14)	(10)	(19)	(21)	(6)	(16)	(3)	(37)	(13)
LW	667	28	648	126	179	188	256	44	105	52	47	159	154
	(78)	(2)	(102)	(7)	(6)	(13)	(22)	(4)	(8)	(6)	(8)	(28)	(24)
C	968	37	487	24	137	113	198	33	81	51	22	335	327
	(25)	(50	(25)	(12)	(13)	(5)	(9)	(24)	(5)	(22)	(1)	(65)	(29)

Skills codes:
1: skate forward 2: skate backward 3: glide forward 4: glide backward
5: pivoting 6: standing 7: stopping 8: body-check give
9: body check receive 10: left lat. cross-over 11: right lat. cross-over 12: left turn 13: right turn

DISCUSSION AND CONCLUSIONS: First, all significant differences found between frequencies of skills on the basis of playing conditions must be regarded carefully. Since the time spent in each of the conditions was not tabulated the differences found between the conditions may simply be the result of more time spent in one condition than in the other, although the differences found may be real.

It seems that our original definition of skills was too discriminatory and was hiding differences that existed. As originally suspected, the defence players were observed travelling backwards or modifying their direction of travel more often than the forward players. This tendency is consequent with the role played by the defence players, who have to protect their own zone from the opposing teams' attacks and therefore must skate backward to keep the play in front of them.

A possible explanation for the lack of differences between the University and the Major Junior playing levels is that a large number of the University level players were former Major Junior players. As such, their playing style was most surely tainted from the time played at the Major Junior level.

Possible outcomes from this study may come in the form of different training and developmental approaches for the different positions. Current training approaches tended to train defence players more in backward skating than the forward skating. This study justifies this current practice. The same can be said of the pivoting skill, which the defence players tended to execute more frequently.

Future TMA studies on ice hockey game should include the time characteristics of play conditions in order to allow a better comparison of the frequencies of skating skills. A computer assisted video-based data coding system should be developed to implement the time factor and to accelerate data acquisition. Similar study should be done for professional and women's leagues.

REFERENCES:

Ali, A., Farrally, M. (1991). A Computer-Video Aided Time-Motion Analysis Technique for Match Analysis. *J. of Sports Med. Phys. Fitness* **31**, 82-88.

Bracko, M. (1992). Time Motion Analysis of the Skating Characteristics of Professional Ice Hockey Players. Ph.D. Dissertation. Brigham Young University, Department of Physical Education.
Clayton, H. M. (1993). Development of Conditioning Programs for Dressage Horses Based on Time-Motion Analysis of Competitions. *J. Appl. Physiol.* **74**, 2325-2329.
Docherty, D., Wenger, H. A., Neary, P. (1988). Time-Motion Analysis Related to the Physiological Demands of Rugby. *J. Human Movement Studies* **14**, 269-277.
Mayhew, S. R., Wenger, H. A. (1985). Time-Motion Analysis of Professional Soccer. *J. Human Movement Studies* **11**, 49-52.
Slater, M. R., Sewell, D. F. (1994). An Examination of the Cohesion – Performance Relationship in University Hockey Teams. *J. Sports Science* **12**, 423-431.

Acknowledgements:
The authors would like to thank the Canadian Hockey Association for funding this study, the managers, coaches and players of University of Ottawa Gee Gees and Ottawa 67 for participating to this research.