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Hand and Lateral Preferences and Playing Style in Ice Hockey

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----------ABSTRACT----------

When performing a one-handed activity, individuals mainly use their most efficient hand, thus exhibiting manual preference. In bimanual activities such as playing guitar, the act of plucking the strings is commonly executed by the more skilled hand while the other hand holds the neck, thereby indicating a lateral preference. Hand preference is generally a good predictor of lateral preference. However, in ice hockey, there are many cases where, for example, right-handers shoot from the left. In the present study, we test the hypothesis that the playing style adopted by a player and the manner of gripping the stick—dominant hand above the other hand or vice versa—are linked. The results obtained from 194 players confirm the hypothesis.

Players who hold the end of the stick with the dominant hand have a playing style that is more focused on finesse, while players who hold the end of the stick with the non-dominant hand have a playing style that is more focused on power. These results are analyzed on the basis of certain principles of cooperation between the hands.

Keywords: laterality, manual preference, ice hockey, playing style.

INTRODUCTION

Daily manual activities in humans can be classified into three categories (Guiard, 1987). First, they can be unimanual: such is the case, for example, when brushing your teeth. In such a case, we will see that the person performing the action has a manual preference. Two other categories of activities are referred to as bimanual and can be either symmetrical or asymmetrical. In a symmetrical bimanual activity, such as climbing a ladder, both hands play a similar role. A bimanual activity is considered asymmetrical when each hand is assigned different roles: the practice of string musical instruments is an example (Guiard, 1987). In the latter case, the person who performs reveals a lateral preference (Guiard, 1989).

In an asymmetric bimanual activity, the role assigned to each hand can generally be predicted based on lateral preference. Thus, we can expect that if we present a violin to a right-hander who has never played one before, they will spontaneously try to hold the instrument with the left hand and the bow with the right hand. To explain this preference, Guiard (1987; 1989) proposes certain principles of cooperation between left and right hands. A first principle stipulates that the dominant hand tends to organize its action according to a position defined by the non-dominant hand and not according to an absolute position. This kinesis/posture contrast (Guiard, 1985), when applied to a right-handed manual preference, is called the "right-to-left reference principle" (Guiard, 1989). A second principle indicates that the relative contributions of the right and left hands are guided by an assignment of the dominant hand to the task with a micrometric component as opposed to a participation in a macrometric activity of the non-dominant hand. Thus, during an asymmetric bimanual task that involves precise dexterity (fine resolutions), these fine movements, whether they necessitate temporal accuracy or spatial precision, are undertaken by the dominant hand.

Starting from the example of the right-handed person, Guiard (1989) suggests a third principle, the "left-hand precedence principle" according to which, in a cyclical activity, it is first the left hand which makes its contribution. To illustrate this fact, where precedence is given to the left hand, Guiard recalls the action of threading a needle: the needle must first be fixed, which the right-handed person will hold from the left, before the right hand begins its movement.

Even if, most often, hand preference makes it possible to adequately predict the assignment of tasks to each hand in a bimanual activity, there are sports activities where there are numerous exceptions. One such case, that of stick manipulation in ice hockey, is the subject of this study.

For the purposes of this study, let us distinguish two groups of ice hockey players according to their way of holding the stick. The terminology used to designate these two groups draws its inspiration from old martial language and is reported by Guiard (1987). Thus, we will distinguish the *cut* group from the *thrust* group. The cut group refers to players who place their non-dominant hand at the end of the handle, as do those who want to hit the cut grip, that is to say with the slice. This group includes left-handers who place their left hand lower than their right on the stick (in ice hockey, these players are said to shoot from the left[1]); and right-handers who place their right hand lower than their left hand on the stick (these players are said to shoot from the right). In contrast, the thrust group designates the players who place their hands like those who wish to strike in a thrusting position thrust, with the point. In ice hockey, these are left-handers who shoot right and right-handers who shoot left.

We therefore pose the following hypothesis. Hands positioned to strike from the cut favour rotational movements: thus, hockey players in this group should be able to shoot with force. Hands positioned for thrust offer a better chance of executing axial translations and controlling movement in the direction of the thrust: in ice hockey, that should result in better puck control.

Thus, depending on whether they belong to the cut or thrust group, we should see different tendencies appear in the way individuals play ice hockey. On the one hand, cut group players should like to shoot hard, and if they shoot hard, we can expect those players to like to shoot often as well. On the other hand, players in the thrust group should show a preference for a playing style focused on control, and therefore on finesse. By extension, we can expect that these players, preferring to play with finesse, are less inclined to play with force and therefore to defeat an opponent by imposing themselves physically. Finally, we can also expect the players in the thrust group to favour precision, to the detriment of force, on the occasions when they opt to shoot.

In short, we want to verify in this study whether the manner of holding the stick, and more specifically, whether placing the dominant hand above or below the other, can be linked to a particular playing style. Our study therefore consists of a survey on the manual and lateral preferences of ice hockey players, a survey supplemented by an evaluation by coaches of the way these players play. A questionnaire, based on the statements reported in the previous paragraph, was constructed to make these assessments.

METHOD

Subjects

The sample included 194 subjects, all involved in high levels of competitive ice hockey in the Sudbury area, Ontario, Canada. Subjects were selected when their coach agreed to participate in the study.

Fifteen teams, divided according to different categories and classes, participated in the experiment. Table 1 reports this distribution. College-level players were between 18 and 23 years old. Players at the Midget, Bantam and Pee-Wee levels were, respectively, 16 (AA) and 17 (AAA) years old, 14 (AA) and 15 (AAA) years old, and 12 (AA) and 13 (AAA) years old. Classes AA

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[1] From the theoretical perspective proposed by Guiard, it is incorrect to say that a player shoots from the left or from the right. In fact, the player uses both hands, each hand playing a unique role. However, if we say that a player shoots from the left, it means that the puck is normally placed to his left when he releases a shot.

or AAA are used in Canadian amateur hockey to denote a high level of competition. Of these 194 players, there were 71 defencemen and 123 forwards.

Material

Two questionnaires were used in this study. (1) Each of the 194 players had to complete the Edinburgh Handedness Inventory in order to establish manual preference (Oldfield, 1971, p. 111).

(2) The other questionnaire was constructed for the purposes of this study: to identify the players' playing style. This questionnaire includes 14 statements (see Appendix: the statements are reported in English because the study was conducted with English-speaking coaches). The coach had to indicate if the statement adequately described a given player. For each statement, the coach answered, on a scale of 1 to 10, whether he strongly agreed (1) or strongly disagreed (10). For 7 of the 14 questions (3, 4, 7, 8, 9, 10, 12), the coach's agreement indicated, according to the hypotheses posed in the introduction, a preference for a playing style based on control and finesse; while agreement with the other 7 statements (1, 2, 5, 6, 11, 13, 14) indicated a preference for a power-oriented playing style. After the questionnaires were completed, the score on questions 3, 4, 7, 8, 9, 10 and 12 was reversed and the calculation of the final score became the addition of the scores to the 14 statements. In other words, the overall dependent variable extracted from the questionnaire for each player was a score located on a scale ranging from 14 (playing power) to 140 (playing finesse). In addition to this global analysis, the result for each of the questions is analyzed and reported.

TABLE 1. - Description of the sample

		Number		Position		Cut		Thrust	
Category	Class	Clubs	Players	Def.	For	L	R	L	R
Pee-Wee	AA	2	23	8	15	4	4	3	12
Pee-Wee	AAA	3	37	13	24	4	13	5	15
Bantam	AA	3	39	14	25	1	9	4	25
Bantam	AAA	2	28	11	17	1	6	2	19
Midget	AAA	4	49	18	31	2	18	0	29
College	-	1	18	7	11	0	5	1	12
TOTAL		15	194	71	123	12	55	15	112

Def = Defence; For = Forwards; L = Left-handers; R = Right-handers

Of course, the authors recognize that players can be endowed with extraordinary qualities both for the control of the puck and for the strength of their shot.

The objective here is to identify if a trend in the way of playing emerges, on a large set of players, according to their manual and lateral preferences. In short, players in the cut group are expected to score lower overall than players in the thrust group.

Procedure

The procedure took place in two stages. First, the college team coach was contacted. In this high-level team, there was also an assistant coach. Both had a good knowledge of their players. With this team, two characteristics were tested to assess the validity of our playing style questionnaire. We wanted to know (1) whether two observers with good knowledge of a sample of players could make a similar assessment of those players based on the questionnaire; and (2) whether these same observers could be stable in their own evaluations, that is, whether they could, one week after a first evaluation, make a second evaluation similar to the first.

After verifying these two points (see Results), the questionnaire was distributed to other coaches who agreed to participate in the study and who themselves distributed the Edinburgh inventory to their players.

The evaluations by the college team coaches were done in December, and those of the other coaches in January. A hockey season lasts approximately 6 months, from the end of September to the end of March. Thus, the evaluations were made at a time of the season which allowed us to believe that the coaches had a good knowledge of their players.

RESULTS

Before undertaking the analysis of the scores on the playing style questionnaire, an analysis of the validity of our instrument was carried out.

Validity

We took two precautions before using the questionnaire on the playing style: the first, described in the procedure, touches on the coach and the assistant of the college team; and the second concerns the response of each of the trainers participating in the study.

For the collegiate team, a Pearson correlation was calculated between the scores reported by each of the two evaluators during the first evaluation. The correlation, based on the evaluation of 18 players, was .80 ($p < .01$). The correlation between the first and the second rating was .78 ($p < .01$) for the coach and .99 ($p < .01$) for the assistant. This stability of the assistant's judgments probably depends on his training in evaluating players since he is a recruiter for the Junior Hockey League in Ontario, a league where many future professional players develop.

A second precaution was taken to ensure this time that each coach completed the questionnaire seriously. Statements 3 and 14 are almost identical, except that the scale was reversed. The correlation between the scores at these points must therefore have been very high and negative. Table 2 shows these correlations. The highest is -.98 and the lowest is -.71, with the average being -.88. In addition, in order to assess the reliability of the coaches' judgments, a correlation was calculated in order to estimate the link between two aspects of the questionnaire that should lead to similar results: the score for the seven statements where agreement indicates a preference for finesse play, and the score for the seven statements where agreement indicates a preference for power-oriented play. Table 2 shows these correlations, which all fall between -.65 and -.97, with an average of -.84. In short, we have two reasons to believe that the coaches completed the questionnaire seriously.

Sample

Of the 194 subjects, 27 had a left-hand preference (13.92%). This result is consistent with the proportion of left-handers found in the general population, which is about 10% (Hécaen, 1984). 12 of the 27 left-handers (44.4%) are from the cut group, i.e., carry their left hand down the hockey stick while 55 of the 167 right-handers (32.9%) also belong to the cut group since they place their right hand down the stick. This difference in frequency was tested using the chi-square test and is not significant ($X^2 = 1.37$).

Finally, it should be noted that the average Edinburgh Inventory score was similar for each group. For players with a left manual preference, there are no significant differences [$t(25) = .54$, n.s.] between the means of the cut (18.17) and thrust (17.00) groups. Also, for right-handers, the difference in means between the cut (18.40) and thrust (18.89) groups is not significant [$t(165) = .73$, n.s.].

Playing style

Table 3 shows the average results, for each category and each class, and according to manual and lateral preferences, obtained in the questionnaire on the playing style.

Remember that a high score indicates a preference for a style that favours finesse. The difference between the cut and thrust groups is significant for Pee-Wee AA [$t(21) = 2.78$, $p < .01$], Pee Wee AAA [$t(35) = 4.08$, $p < .01$], Bantam AA [$t(37) = 2.39$, $p < .05$], Midget AAA [$t(47) = 3.49$, $p < .01$], and for the college-level team [$t(16) = 2.48$, $p < .05$]. In Bantam AAA, players in the thrust group also had a higher average than players in the cut group, but this difference was not found to be significant [$t(26) = 1.03$, $p = .314$].

TABLE 2. - Correlation between questions 3 and 14 and between the scores on two subscales, for each team

Category	Class	*n*	3 vs. 14	Sub-sample
Pee-Wee	AA	11	-.81	-.70*
	AA	12	-.98	- .86
	AAA	13	-.98	-.82
	AAA	14	-.78	-.92
	AAA	10	-.95	-.95
Bantam	AA	15	-.82	- .85
	AA	14	-.94	-.82
	AA	10	-.82	-.73**
	AAA	13	-.91	-.81
	AAA	15	- .82	-.81
Midget	AAA	12	-.71*	-.65*
	AAA	10	-.91	-.97
	AAA	13	-.98	-.96
	AAA	14	-.85	-.84
Mean			-.88	- .84*

* $p < .05$ ** $p < .01$ (Others: $p < .001$)

For all subjects, the mean score for left-handers and right-handers is 65.43 and 61.67, respectively. For the thrust group, the mean score for left-handers and right-handers is 79.93 and 77.91, respectively. The mean score for all subjects in the cut group (*M* = 62.34) is significantly different [$t(192) = 6.87$, $p < .01$] from that of the subjects in the thrust group (M = 78.15). These results are similar to those obtained in a pilot study[2]. For the different categories in our sample, the tendencies are the same. Moreover, if we divide the sample according to the players' positions, the difference among defencemen between mean of players from the cut (*M* = 56.04) and thrust (*M* = 72.26) groups is significant [$t(69) = 5.08$, $p < .01$]; and this difference is also significant [$t(121) = 5.35$, $p < .01$] for forward players (*M* cut = 65.86; *M* thrust = 81.61).

TABLE 3. – Mean Score (X) and Standard Deviation (SD) in each category and class in each experimental condition

		Cut				*Thrust*			
		Shoot Left		Shoot right		Shoot left		Shoot right	
Category	Class	X	SD	X	SD	X	SD	X	SD
Pee-Wee	AA AAA	73.3 55.5	9.9 19.1	62.8 63.0	5.3 16.3	81.0 91.6	0.4 9.0	79.5 81.5	10.2 16.7
Bantam	AA AAA	67.0 54.0	- -	65.0 71.0	11.8 4.0	-65.0 80.0	2.5 5.6	78.0 74.6	12.8 16.1
Midget	AAA	74.5	36.0	56.9	14.4	-	-	76.2	17.7
College	-	-	-	57.8	18.0	78.0	-	80.0	17.6

Scores can vary from 14 to 140

Finally, for the entire sample, the average for defence players (*M* = 66.77) is significantly different [$t(192) = 3.82$, $p < .01$] from that of forwards (*M* = 76.11): compared to forwards, defence players have a greater tendency to adopt a playing style based on power.

We also compared the cut and thrust groups for each of the 14 questions. Table 5 reports, for each question, the mean scores of these two groups, the value observed in the *t* tests, and the level of statistical significance on this test. It is only in Questions 2, 6, and 11 that the two groups

[2] 2. In a pilot study on the same topic, hand and lateral preferences and playing style in ice hockey, coaches were asked to rate their players on a scale of 1 to 10. A rating of 10 indicated that a player prefers to play aggressively, as illustrated by physical involvement in the game, shooting with force, and a tendency to shoot more often than to deceive the opponent with feints. In contrast, a rating of 1 indicated that the player likes to play with finesse, control the puck, pass rather than shoot, and seek precision when shooting. Thus, a rating of 5 or 6 for example, indicated a preference for a mixed playing style, where no preference for one of these two poles emerges. In this pilot study, there were 34 players, 16 from the cut group and 18 from the thrust group. The first got an average score of 6.19 (SD = 2.37), which indicates a style based on power; and the latter obtained an average score of 4.17 (SD = 2.26), which indicates a preference for a style focused on finesse. The difference between these scores is significant [$t(32) = 7.36$, $p < .01$].

show no difference. For Questions 1 and 5, the difference between the two groups does not meet the conventional critical threshold ($p < .05$) but the tendency of these results is consistent with what was predicted by the initial hypothesis. Finally, for the other nine questions, the differences between the scores of the cut and thrust groups are significant.

TABLE 4. - Mean score (X) and standard deviation (SD) for defence and forward players, and for all subjects in the cut and thrust groups

		Cut	*Thrust*
Defence	*n*	24	47
	X	56.04	72.26
	SD	11.59	13.24
Forwards	*n*	43	80
	X	65.86	81.61
	SD	15.18	15.80
Total	*n*	67	127
	X	62.34	78.15
	SD	14.69	15.52

Scores can vary from 14 to 140

DISCUSSION

The objective of this investigation was to analyze the link between the playing style of ice hockey players and their manual and lateral preferences. Two groups were formed: (1) Cut: left-handed people placing their right hand on the upper part of the hockey stick as well as right-handed people placing their left hand on the upper part of the stick; and (2) thrust: the left-handers placing their left hand on the upper part of the stick as well as the right-handers placing their right hand on the upper part of the stick.

First, it is interesting to note that the distribution of players in the cut and thrust categories is not attributable to chance. If that were the case, we would have had half of the players in each group. Similarly, we are very far from the case of field hockey where the players hold the stick with the left hand at the end of the stick (shoot from the right), even if we can assume that most players are right-handed. Thus, for ice hockey, since there are more players in the thrust group, and considering the results of the study, it is reasonable to believe that the control of the puck has more weight than shooting with force in lateral preference.

In fact, players using a cut grip were expected to favour a power-based playing style while players using a thrust grip were expected to adopt a style based on finesse. Based on the evaluation of the playing style of 194 players by their coach, the hypothesis was confirmed. The difference between the two groups is significant, and it is found both with left-handers and right-handers; and with defence and forward players. Moreover, this difference is found in almost all categories and classes, i.e., for different age groups and based on evaluations by different coaches.

On the other hand, the analysis of each of the statements of the questionnaire makes it possible to verify on several occasions that the players of the cut group, compared to the players of the thrust group, have a greater tendency to play with force rather than puck control. Furthermore, it is interesting to note that the two groups do not show any difference in their answers to Questions 2 and 6. Thus, in a situation where two players are going up against a single opponent, players of the cut group are not more likely to shoot than the players of the thrust group even if, in general, players from the latter group prefer to pass and control the puck

TABLE 5. - Mean score (X) and standard deviation (SD) for each question for both cut and thrust groups

Question		*Cut*	*Thrust*	t	*p* <
1	X SD	4.63 2.88	5.23 2.78	1.40	.16
2	X SD	5.01 2.38	5.26 2.40	.68	.50
3	X SD	7.04 2.74	6.07 2.87	2.28	.03·
4	X SD	6.07 2.26	5.01 2.19	3.19	.01
5	X SD	4.06 2.44	4.72 2.34	1.83	.07
6	X SD	4.91 2.61	5.23 2.44 ·	.84	.40
7	X SD	6.52 2.67	4.45 2.41	5.49	.01
8	X SD	6.25 2.34	4.46 2.23	5.25	.01
9	X SD	5.82 2.93	4.29 2.28	4.37	.01
10	X SD	6.25 2.43	4.73 2.41	4.17	.01
11	X SD	3.81 2.62	4.04 2.53	.60	.55
12	:X SD	5.67 2.33	4.73 2.14	2.82	.01
13	:X SD	4.81 2.51	5.80 2.44	2.66	.01
14	X ET	3.72 2.80	4.69 2.93	2.22	.03

Scores can vary from 1 to 10.

rather than shooting (Question 8). Also, in a situation of breakaway in front of the goalkeeper, the players in the thrust group did not have a stronger tendency than the players in the cut group to use stick handling rather than shooting. Thus, for certain specific game situations, the players from both groups make the same choices. On the other hand, when they use shooting (Question 7), players in the cut group rely more on strength, while those in the thrust group choose to bet on precision.

These results can be explained by Guiard's (1987; 1989) theoretical interpretation of the role of asymmetry in the context of human bimanual activities. Guiard (1987) first proposes that each hand is a motor. He also suggests that these two motors would form a kinetic chain and act as if they were assembled in series. Thus, to fully understand an asymmetrical bimanual action, there is a need for looking at how the movements produced by each hand are articulated. This vision encompasses the three principles reported in the introduction and to which it is appropriate to return to integrate them into the context of ice hockey.

The principle of spatial reference stipulates that in a bimanual activity, in the case of an individual with a right-handed manual preference, the left hand plays the role of positioning from which the action of the right hand is exerted. This description implies a notion of temporality where the left takes precedence over the right (principle of precedence). According to these principles, one would expect that in ice hockey there would be more right-handers shooting with their right hand down and left-handers shooting with their left hand down, which is generally not the case, as our sample indicates. Guiard (1987) reports that right-handed people should be expected to prefer placing the left hand above the right hand in any activity, such as golf, where a long strike is required. In fact, if all efficiency in ice hockey were to hold single-swing outcomes like in golf, then the distribution of lateral preferences in ice hockey would likely approximate that of golf. However, this is not the case, because hockey has an additional component, that of the organization of the game, which requires efficiency in controlling the puck.

According to the second principle articulated in the introduction, that states that the dominant and non-dominant hands are respectively assigned to micrometric and macrometric activities, it would be to the advantage of the right hander to allocate the right hand to movements of lesser magnitude. So, by placing their right hand on top of the stick, the right-hander should be more efficient when dribbling, i.e., to control the game. Similarly, for passing, the top hand generally moves less than the bottom hand (Walford, 1971). Even for shooting, the displacement of the hand placed higher is less than that of the other hand.

This is obvious for the slapshot and is also true for a very effective type of shot, the "snapshot" (Halliwell, Groppel, & Ward, 1978). So, if the right handers give the right hand a spatial reference role by placing it above the left hand, they should be able to shoot accurately. In this case, the left hand then becomes responsible for completing the action: the power of the shot of one such right-handed person should be less than the power of the shot of a right-handed person who places the left hand higher, thus leaving the action to be completed by the dominant hand, the right.

CONCLUSION

This study was carried out with 194 hockey players and made it possible to note that the distribution in this sport of the number of left-handers and right-handers is consistent with that encountered in the general population. It is, however, interesting to delve into the distribution of these players, according to their lateral preference. 34.5% of players use the cut grip, i.e., the grip that favours swinging and that is commonly found in cricket, baseball, and field hockey. 65.5% of players use a thrust grip, that is to say a grip where the preferred hand is placed at the end of the handle, as billiard players do, for example. Finally, the study clearly demonstrates that the playing style in ice hockey differs depending on whether a player adopts a grip favouring a cut or thrust action. In the latter case, players like to control the puck, choose to shoot with precision rather than force, and do not tend to impose themselves physically. We believe that these results are of interest not only to ice hockey theorists, but also to neuropsychologists who work on the vast problem of manual and lateral preferences; and we hope that this study will stimulate research on laterality in the particular case of ice hockey.

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Appendix

1. Player enjoys using his slapshot much more than the wrist shot.

2. In a two-on-one situation; the player would much rather shoot the puck than pass it.

3. Player dislikes being involved in a physical type of game.

4. Making precise passes is what the player does best.

5. Whenever the player gets an opportunity, he shoots the puck.

6. On a breakaway, the player would much rather shoot the puck than deek the goaltender.

7. When the player shoots the puck, he tries to pick the corners rather than utilizing a bard shot.

8. Player relies more on a passing game than on a shooting game.

9. Player has excellent stickhandling abilities.

10. Player has no problems controlling the puck for a long period of time.

11. Player enjoys going into the corners and digging the puck out.

12. Player has no trouble making passes, either forehanded or backhanded.

13. The player's stickhandling abilities are not as good as his slapshot.

14. Player enjoys playing a physical game.