Comparing Defensive Pressures Using Possession Retention Probability and Expected Goals

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Abstract. Hockey places a high value on possession time and efficiency as a way to generate offensive success and improve win probability. Under this guiding principle, this work will employ a possession-based framework to evaluate events in terms of their impact on a teams' possession retention probability. Finally, a metric will be introduced to evaluate player actions by their resulting offensive potential in different situations. A case study investigating puck protection strategies on offence and defensive pressure techniques such as bodychecking will illustrate the application of this metric and lead into areas of future analysis.

Keywords: hockey analytics · spatiotemporal analysis · sports statistics

1 Introduction

Puck possessions play an important role in dictating the outcome of hockey games. Metrics such as CORSI and FENWICK [1] have demonstrated that the more frequent and higher possession quality that a team has, the better their opportunities to generate scoring chances. Conversely, defensive actions that force a change in possession should be similarly valued by teams and analyzed accordingly. In this paper, defensive pressure techniques will be assessed for effectiveness by examining resulting offensive opportunities.

An extension of this work will focus on physicality (in the form of checking) and its statistically observable impact on offensive output. Gone are the days of the fourth line goon, crushing hits and heavyweight bouts unfolding on the ice. In hockey today, speed and skill are paramount. Hits per game are on the decline, and with it, strategies are evolving. Body checks and stick checks are two principle methods of forcing a change in possession, though due to a decline in physicality, the former is seemingly being phased out of the game. In our literature review of previous studies conducted in hockey analytics, the projects that have utilized similar data sets have overwhelming focused on passing related metrics [2–4]. Additionally, competitions such as the 2021 Big Data Cup worked with women's hockey datasets, a league in which body checking is prohibited. Thus, applying our possession-based event valuation framework to bodychecking and puck protections delves into a relatively understudied and potentially valuable area in the hockey analytics space.

2 Background

The analysis was conducted using event data provided by Sportlogiq from twenty games played during the 2020-2021 season in the Swedish Hockey League (SHL). Table 1 displays the different types of recorded eventst, broken down into three categories: **Possession-Continuing**, **Possession-Terminating**, and **Other**. Possession-continuing events take place while one team attempts to advance an offensive possession, and can be disrupted by actions performed by the defending team, causing a live change in possession. They differ from possession-terminating events, which result in an automatic play stoppage, such as a penalty or offside, or a voluntary relinquishing of possession, such as a dump in or shot on goal. Events that didn't fit in the previous two categories were place in the "Other" category and served as event descriptors (such as an assist describing a pass) or an event where no team is in possession, such as a faceoff.

Table 1. Categorization of Event Types

Possession-Continuing	**Possession-Terminating**	**Other**
carry	shot	save
pass	dump in	rebound
puck protection	dump out	controlled entry
loose puck retrieval	offside	controlled exit
check	icing	faceoff
reception	penalty	shootout events
controlled entry against	penalty drawn	goal
block		assist

The most pertinent events to this project were player interactions, primarily checks and puck protections. Although basic familiarity with hockey is assumed, a brief explanation about such interactions will be given. An offensive player can attempt to protect the puck by either shielding it with their body or performing a "deke", where they use their stick to maneuver the puck around their defender. In the flow of a game, checking occurs via the defender's body or stick and serves to disrupt a play in the hopes that the ensuing loose puck can be retrieved by the defending team. Body checking is used to take an opposing player out of the play by physically knocking them off the puck. This can take the form of open ice hits and checks along the boards, though as Figure 1 shows, the majority happen in the defensive zone (shown on the left) along the boards. While body checking takes the opposing player off the puck, it can also take the defending player making the check out of the play, which has strategic ramifications requiring the need for coverage from supporting teammates. Stick checking takes advantage of the hockey stick as an extension of the player's body, allowing them to knock the puck off of or lift an opponent's stick. Positioning of defending players remains an important factor in this form of checking, though infractions such as tripping, high sticking or slashing are more likely to occur in the use of stick checking.

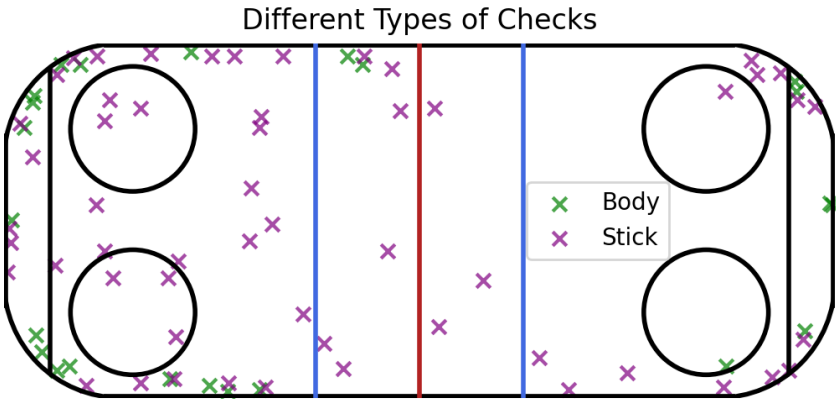

Fig. 1. Spatial Distribution Example of Stick Checks and Body Checks From a Game

3 Methods and Algorithms

With the event categories established, a model was developed to predict possession retention probability within the next two plays of a possession-continuing event. Offensive and defensive actions within this set were assumed to be disjoint, with the few overlaps in the data removed. Eleven features mirroring those used in similar outcome probability models were selected: the period, time remaining in it, amount of skaters on ice for both teams, whether the player in possession is on the home team, the score differential, the (x,y) coordinates for the event, the name and type of event, and the position of the player (Forward/Defense). An xgboost model was created and tuned using a random search strategy over 10 iterations. It had a test AUC of 0.795, an overall accuracy of 84.73% on the withheld test set and a balanced accuracy of 72.16%. From its predictions, checks had the highest average expected turnover probability of any defensive pressure technique, at 59.8% for body checks and 57.5% for stick checks.

Inspired by VICE [5], a metric was created to quantify the change in expected goals (`xG`) that each event gave to the team in possession. For every event, the next 45 seconds (average hockey shift length [6]) was observed and the xG of each shot within that time frame was summed. The difference (or sum in the case of a change in possession) in xG before and after each event was then was calculated. This difference was multiplied by the proportions of shots that came from that region of the ice as an estimate of shot probability, and finally multiplied by the predicted possession retention probability of the play in question. We denote the resulting value as `DeltaXg45s`, and it represents how important a play was in generating resulting xG, contrasting the "risk" involved in committing the action with the "reward" in terms of generating a shot from the location of the event. A larger value when comparing play types indicates a higher value in terms of generating offense.

4 Overview and Discussion of Findings

The average DeltaXg45s for puck protections and checks were compared by type (stick/body for checks, deke/body for puck protection) and in the aggregate with 95% confidence intervals superimposed on each bar. Addition comparisons were made by their magnitudes (Figures 2 & 3) and raw values (Figures 4 & 5). Outliers on the lower end of magnitude were filtered to de-noise the impact of significant plays, and events that did and did not result in a change in possession were compared independently due to their large differences in DeltaXg45s.

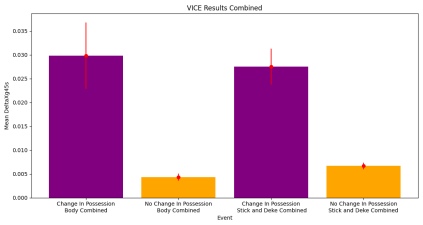

Fig. 2. Aggregate Magnitude Comparison of Checks and Puck Protections.

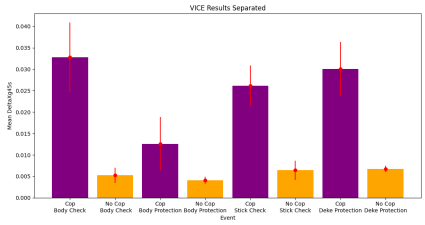

Fig. 3. Separated Magnitude Comparison of Checks and Puck Protections.

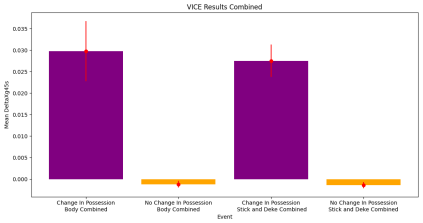

Fig. 4. Aggregate Raw Value Comparison of Checks and Puck Protections.

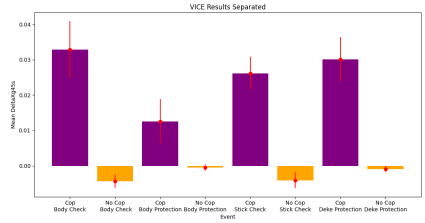

Fig. 5. Separated Raw Value Comparison of Checks and Puck Protections.

From Figure 2 we see that the magnitude of DeltaXg45s of stick checks is larger than that of body checks when there is no change in possession. This could be because using one's body takes the opposing player out of the play, while a successful deke could take the defender out of the play and increase the chance of an odd man rush which comes with a higher chance of generating xG. This difference is not observed when raw values are used, which suggests that the magnitudes are higher in both directions on deke attempts and lead to bigger changes in xG for both teams during a game. When looking at the difference in magnitudes with puck protections and checks separated, a change in possession on a body puck protection offers significantly less offense than the other type of forced turnover. This could be because a body check takes both players out of a play, so if the puck is not knocked loose (a check event), then the player with the puck is already being marked by the player they just took the puck from, limiting their ability to generate offence. This result is echoed in Figure 4, further

suggesting that a body check generates less resulting offense after a change in possession. When there is no change in possession on a body puck protection, there is less of a change in offence generated by the team in possession than if the same situation occurs with a stick protection instead. The reasoning is that retaining possession after a body check does not guarantee the ability to create separation from the defensive player. In summary, these results suggest that there is a statistically significant difference between using one's body and one's stick on both puck protections and checks, and that eliminating body checks may have negative effects on available strategies. For example, if body checks generate less offence, a coach may opt to send out their players to hit more in order to slow the game down when things are getting out of hand for the team.

5 Conclusion and Future Steps

With our possession-based event valuation framework, we found that while body checks have a higher turnover probability than stick checks, they generate less resultant offence than stick checks on changes in possession. Additionally, when there are no changes in possession, body checks have less impact on DeltaXg45s than stick checks. This suggests that body checks and stick checks have important but distinct use cases, with their exact impacts necessitating more robust analysis. If more data was available, one could look at checks and puck protections by zones of the hockey rink to see whether certain types are more effective in certain areas, such as along the boards verses at center ice. More intricate tracking data could also analyze decision making of these defensive pressures by considering the location of other teammates on the ice at the time of an event.

6 Code Access Links

The code for this project is linked here: `https://github.com/awosoga/linhac2023`

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