Where did they get out? Evaluating zone exits using expected threat in hockey

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Abstract. Analyzing the effect of zone exits in hockey through different lanes one the ice. The paper introduces an implementation of the soccer metric expected threat adjusted for hockey. Additionally to offensive expected threat, the metric also quantify defensive danger. The metric is used to analyze the xT for sequences of passes and carries leading up to a zone exit and compares the different lanes.

Keywords: zone exit · expected threat · entry/exit lanes

1 Introduction

1.1 Zone Exits

Good defense in hockey is mostly determined by minimizing the scoring chances of the opponent by keeping them away from dangerous areas and suppressing shots from these areas. Successful zone exits at the same time decrease the danger of the opponent scoring and require a zone entry to get into the scoring position. But are all zone exits the same? Do exits in different locations have different impacts on the danger of the opponent? Personal observations would lead to the thesis that zone exits over the sides is more effective and danger-reducing but is that really true?
Looking at the controlled exits in the dataset and the events leading up to it is what we are trying to answer in this project. We are using the concept of offensive zone entry lanes introduced by Daniel Weinberger [1] and re-introduced by Nick Czuzoj-Shulman in his 2022 SEAHAC presentation [2] to apply it to the zone exits locations.

1.2 Expected Threat (xT)

The concept is based on Sarah Rudd's work on evaluating actions in soccer using Markov chains [5] that was further developed into the concept of expected Threat by Karun Singh [6]. The concept gives a value to every section of a field to show the probability of scoring a goal in a certain amount of action from that place on the field. Through the difference between the beginning and ending coordinates of an action that moves the ball, the difference in the values is the expected Threat (xT) added through that action. In a presentation at a Football Analytics seminar [7] Hugo Fabrègues presented his new approach to Expected Threat by defining expected Threat with absorption state 1 for a scored goal and -1 for a conceded goal. After application of the markov chain simulation, the resulting matrix is a symmetric shape of xT values that includes the danger of scoring a goal but also the danger of not scoring a goal.

2 Implementation

2.1 Implementation of Expected Threat (xT)

The implementation of expected threat in hockey is largely based on the implementation of expected threat in soccer by David Sumpter and Aleksander Andrzejewski [8]. The start was made by dividing the hockey rink into a 16 $\times$

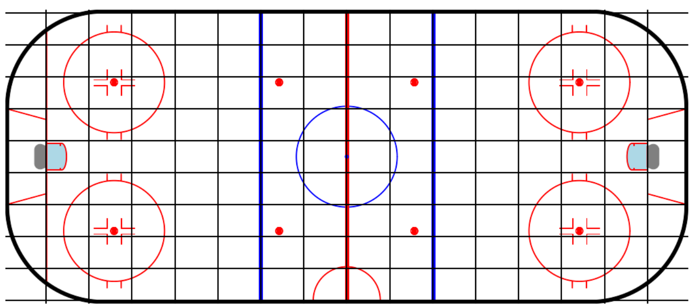

Fig. 1. Dividing the ice into a grid 16 sections (length) and 9 sections (width) for the implementation of expected Threat.

9 matrix (length $\times$ width) to have the zones aligned with all the important sections of the ice (fig. 1). Only passes and carries were defined as move actions to make ensure consistency. First, we calculate the probabilities of the puck being moved from a specific tile or if there is a shot taken from that tile, the so-called move probability. The goal probability is simply taken by the expected goals of all shots in the Sportlogiq dataset. Following the algorithm for transition matrices in the tutorial [8] is used to calculate the probability to go from to a specific tile from a given tile for every tile on the ice. Using the transition matrices, goal probability, and moving probability we now use the Markov chain technique to create the transition matrices after a certain amount of steps until it converges after 8 moves. Now the matrix has all the values for the offensive expected threat. To get the defensive expected threat we flip the matrix and multiply the values with -1. This way we get the expected Threat against the matrix. Finally summing up the both matrices element-wise results in the net xT matrix (fig. 1) that is used in the analysis. The model is agnostic of the team in possession

at the moment and only depends on the position on the field. Although we did not calculate it with the same absorption states as Fabrègues [7] we get a result with a similar basic idea.

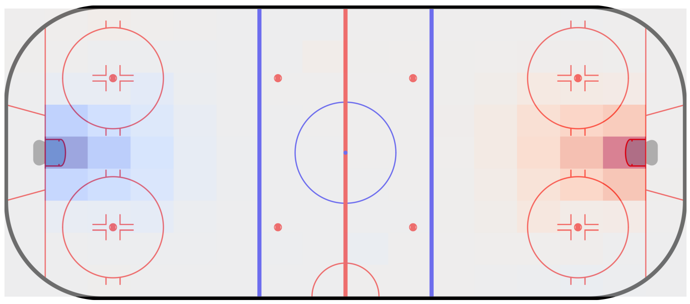

Fig. 2. Values of each zone for the xT net graphic where red are positive values and blue negative values.

2.2 Exit Sequences

In the analysis, we want to use multiple moving actions leading up to an exit. Utilizing the way David Sumpter and Aleksander Andrzejewski isolated possession chains [9] we implemented an algorithm that creates sequences breaking off at game stoppages, definite possession changes as well as a controlled exit. Later analysis was possible this way by getting the 3 moving actions (passes and carries) leading up to a controlled exit. The last action is usually the action fulfilling the zone exit.

2.3 Exit Lanes

Similar to Weinberger [2] and Czuzoj-Shulman [2] for zone entries the idea was to create zones along the width of the ice for the zone exits, resulting in 5 bins. The first idea was to take the coordinates of the controlled exits in the data set and bin the coordinates along the y-axis. Because the coordinate is not necessarily the coordinate where the puck crosses the blue line but where the action fulfilling the controlled exit ends. By calculating the intersection of the action leading to the zone exit we projected the crossing coordinate. Now the exit lanes for the controlled exits especially towards the middle of the ice are a different because for example common breakout passes break the lines we created [10]. For that reason, the intersection exit lanes were used for the analysis.

3 Results

Exit sequences were used to filter the last 3 moving actions before successfully exiting the zone. The passes and carries may not directly follow each other, but they are related to the same sequence leading up to a zone exit. Typically, the last action is the one fulfilling the zone exit.

As the exit sequences are mixed, we did not differentiate between carries and passes. In the results, we found that the peak values for the left and right lanes were quite high, but the middle lane was also able to compete for the highest net xT in a sequence (fig. 3). Surprisingly, the left lane also had the lowest values in a sequence, which was not the case for the right lane. The graph shows that the higher average values for the left, right, and middle lines come from a view of very high net xT events. Most of the values for all lanes are in a similar range.

Overall, it is evident that the right and left lanes have the most zone exit

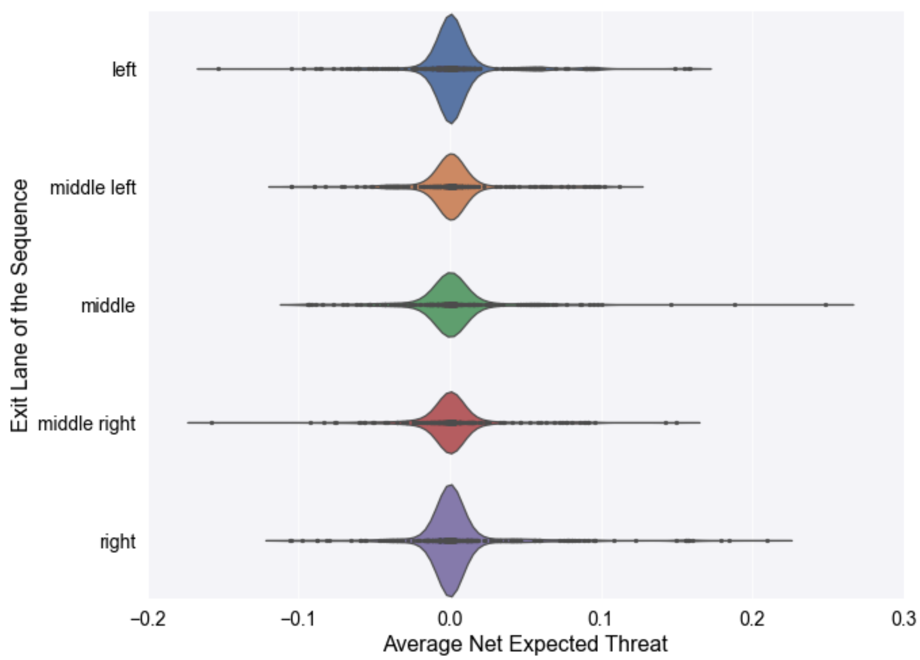

Fig. 3. A violin plot displaying the xT net values for exit sequences group according to their exit lanes.

sequences and therefore have the potential for the most extreme values. A very good play outside the middle could also have high net xT values. This could be due to xT against, which reduces the danger of conceding a goal, or high xT for value that describes the increased possibility of ending up in a good scoring position. All in all, the results show that most zone exits occur over the outside lanes, but the expected threat values are not conclusive enough to show that there is more danger created or prevented by exiting the defensive zone via one of the outside lanes.

4 Discussion

Over the project, there are for sure some more statistical adjustments possible. For example with the expected goals values or use a distribution instead of line intersections to model the locations of the zone exit. Further work might also include looking at different pass types and carry types instead of categorizing them all as a whole. Another idea would be to look at the effects of the moving actions after a zone exit to look at how the exit lane affects possibilities in the neutral zone and the transition into the offensive zone. Some great work was already done on that by Daniel Weinberger [1] and Jen LC [4].

5 Acknowledgements

The Author thanks David Sumpter and Aleksander Andrzejewski for making their code of the soccer implementation of expected threat and possession chains publicly available. I do not take any credit for the code part that belongs to their copyright and is clearly marked in my published notebook, which I adjusted for a hockey context. Another Thank you is extended to Vincent Karpick for the hockey_rink package.

The code is availabe on GitHub: https://github.com/TK5-Tim/linhac/tree/main/2023

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