Passing patterns and xG on the Powerplay

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The Setup

Whether you're a casual viewer or a lifelong hockey analyst, you know that efficient passing is key to a great offense. Cross crease, outlet, stretch or just a good ol' fashioned tape to tape, good passing leads to goals. While a gorgeous goal might make the highlight reel, a scoring play or a good look always starts with crisp, effective passing.

For our question of interest, we wanted to focus on what types of passes resulted in the high efficiency and effectiveness. Specifically, which types of passes and how many of those passes resulted in the best scoring opportunities. And to measure the effectiveness of passing, we used expected goals per each shot.

Expected Goals model

Our expected goals model was developed based off of those created by EvolvingWild and MoneyPuck. We similarly used an Extreme Gradient Boosted model using the binary, linear regression solver to calculate our expected goals, or `xG` values. Taking advangantage of the additional shot data contained within the data set (whether or not the shot was a one-timer, or whether there was traffic on the shot), our model used the following variables:

1. Time elapsed in period
2. Number of home skaters
3. Number of away skaters
4. X and Y coordinates of the shot location
5. Type of shot (Wrist, snap, slap, etc.)
6. Whether or not the shot was a one-timer
7. Whether or not there was traffic on the shot
8. Whether or not the shot was taken on the rush
9. Whether or not the shot was off of a rebound
10. The distance from the net of the shot location
11. The angle of the net of the shot location
12. The difference in time between the last event

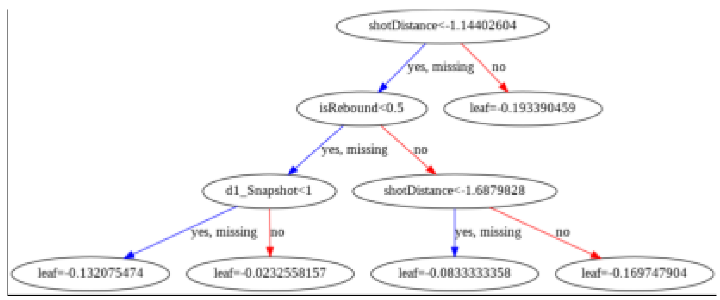


Figure 1.

Our model scored a 96% accuracy on our testing data. Overall, it accurately predicted a goal 91% of the time, all of which were **Type I** errors, or false negatives.

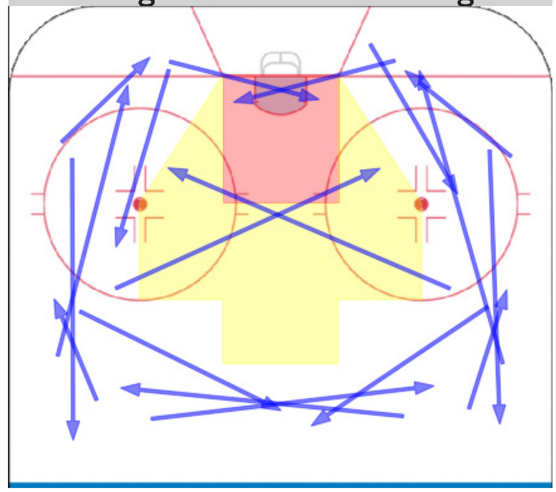
Passing Clusters

Now that we have a metric to evaluate how likely a goal is to be scored off of a given shot, we want to figure out how to classify each of the passes in the offensive zone. In the combined data set, there were 14,673 completed passes, which does not even include incomplete pass attempts. To try and the most common patterns in the passing data, we used the KMeans unsupervised learning method to figure out the most common clusters of passes. We set `n_clusters` to 18, which means we wanted to summarize the 18 most common passes out of the 14,673 completed passes. We created patterns for both passes at even strength and on the power play.

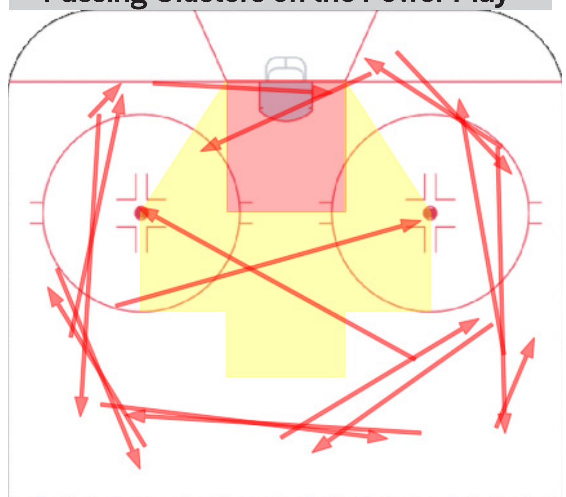
The passing patterns at even strength and on the power play tend to be pretty similar. The two noticable differences between two patterns are:

1. Passing at even strength appears to be more symetrical, compared to Power Play passing which seems to favor the left side, probably due to a cycle running counter clockwise
2. There are more passes that originate from behind the net at even strength than on the powerplay.

Passing Clusters at Even Strength

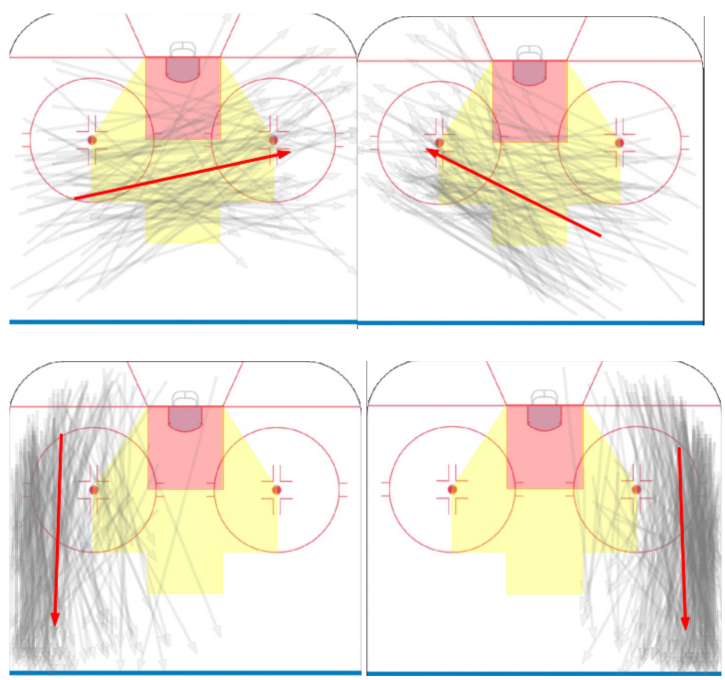


Passing Clusters on the Power Play



Lateral and Low-to-High passes

However, more importantly for our question, lateral and low-to-high passes are defintely among the most common passes, including on the power play. We see clearly in Fig. 3 that there are less lateral passes attempted than low to high passes. In addition the spread of the lateral passes is far greater than the spread of low to high passes.



	Completed	Attempts	Completion %
Lateral		179	0.731
Low-to-High		115	

Quantity of passes' effect on Expected Goals

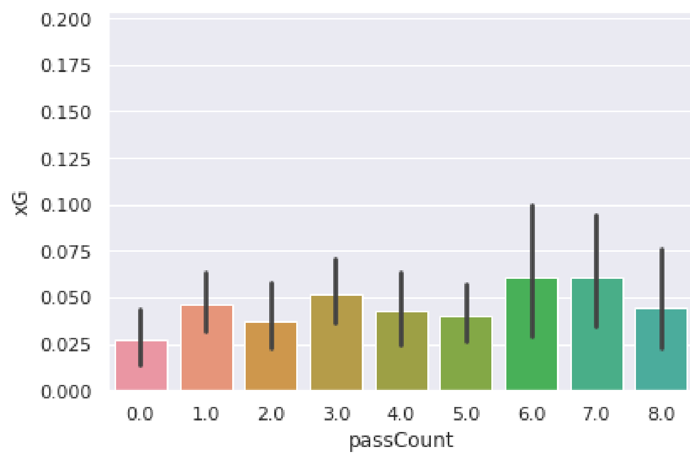
Not all passes are created equally, unfortantely. We now want to see the effect making a certain type of pass has on the `xG` of a shot off of apossession during the power play. In addition, we want to see if increasing the number of passes made -- regardless of their quality -- can result in a higher `xG` during a possession.

We defined a posession as the series of events that takes place from the time the team on the power play takes possession of the puck (regardless of the zone) to the time that same team either a). attempts a shot or b). looses possession of the puck. Under these rules, shot attempts directly off of rebounds count as their own possession.

In each of the possessions where a shot concludes the possession, we calculated how many of each of the 18 types of passes were taken before the shot, as well as the number of total passes, and the number of passes taken specifically in the offensive zone. We then analyzed the effects of the quantity of each of these types of passes and their effect on the shots they generated.

Quantity of total passes prior to shot attempt

We found that on the power play, there is a slight correlation between the number of passes made prior to the shot and the resulting `xG` value. Though there are a few fluctuations, the mean `xG` for each quanitity of passes increase as you increase the pass number. The fluctuations are probably due in part to the smaller sample size for certain pass quanitites. Though the max number of passes on a power play possession resulting in a shot attempt was 17, we limited our analysis to only look at the range [0,8] number of passes prior to a shot attempt.

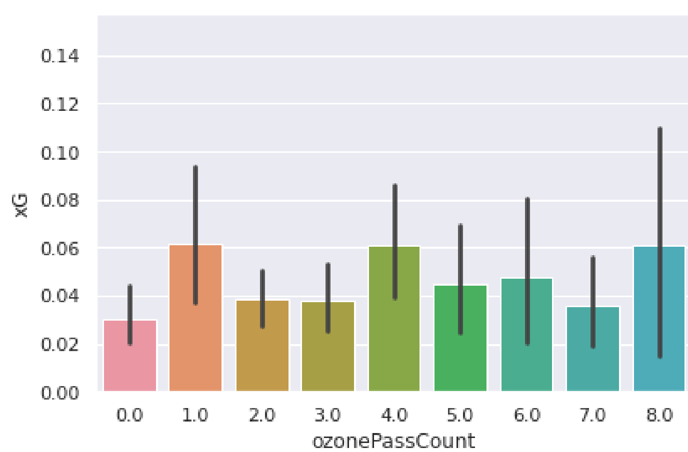


It is important to keep in mind that the `xG` values with 0 passes prior do not include rebound chances, which we chose to exlucde from our analysis. The mean `xG` for 0 pass attempts prior to a shot including rebounds was `0.062`.

However, these pass attempts do include those generated off of the rush, which naturally will cause a higher `xG` than normal

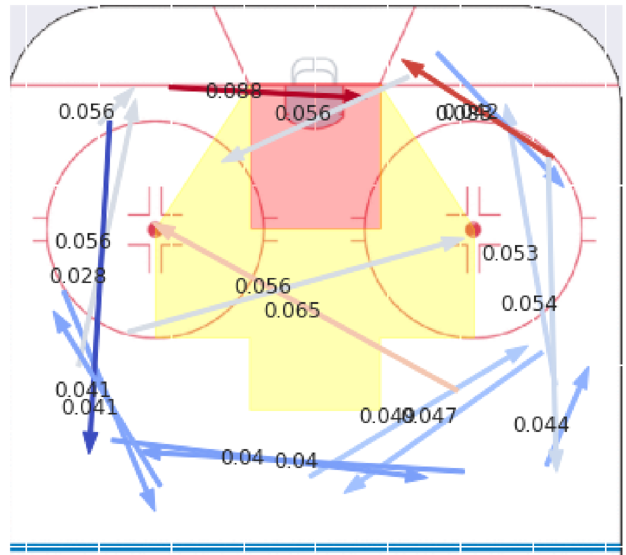
Quantity of offensive zone passes prior to a shot attempt

An increase in the number of offensive zone passes before a shot attempt can similarly predict an increase in `xG`. These passes could also be more directly tied to resulting in a goal, as the total pass count can include passes made on the breakout or in the neutral zone.



Type of passes' effect on Expected Goals

Again, not all passes are created equally. By looking at **xG** values by pass cluster, we can see there is a clear connection between the type of passes completed during a posession and the liklihood of generating a quality scoring opportunity and getting points on the board



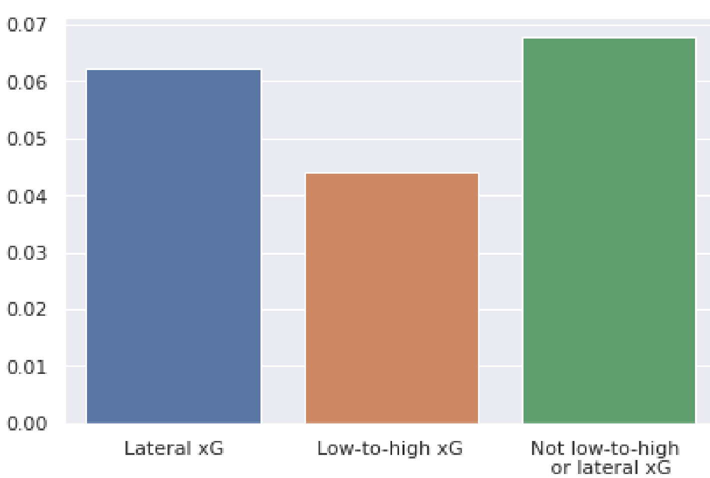
Each of the 18 mean **xG** values for each pass cluster were calculated using shot attempts that stemmedf from a possession that included at least one type of that pass. This means that number of possessions used to calculate all of the mean **xG** values is greater than the total amount of poessessions, since some possessions will contain more than one pass type and will subsequently be used in the calculation of the mean **xG** of all the included pass types.

Let's take a look at our passes of interest: low-to-high and lateral passes

Low-to-High Passes vs. Lateral Passes

We previously hypothesized that low-to-high and lateral passing would be both two of the most common types of passes and two of the most effective passes in terms of creating scoring chances and goals.

As expected lateral passes yield a higher average **xG** than low-to-high passes. While low-to-high passes create open space for the defensmen to get shots on net, the shots generated are typically coming from lower danger zones like the point.



In contrast, lateral passes, if sucessfully completed, distrupts the flow of the penalty killer's defense and places reciever in a high danger zone. However, as these zones are more carefully marked by penalty killers, it is harder for these passes to get through.

Using our completion rates for lateral and low-to-high passes we calculated before, we can can calculate an "effective **xG**" in order to balance the trade-offs of each pass type. This equation will be simply defined as such for every pass i:

$$Effective\ xG = xG_i \times completionRate_i$$

Pass	Completion Rate	xG	Effective xG
Lateral	.730	0.062	0.045
Low-to-high	.911	0.044	0.040

After adjusting for pass completion rate, the effective **xG** become very similar. By running a t-test with $\alpha = 0.05$ on both the original **xG** and the effective **xG** to determine if a significant difference exists between the two types, we find that a significant difference does exist between the original **xG**, but not the effective **xG**.

Comparing all different pass types

Comparing to even strength

In Practice

Conclusion