Quantifying Skill Under Pressure

June 17, 2019

Overview

This report details different ways to evaluate how players perform under pressure. We start by going over the data set used for this report. Next, we give some high-level summary statistics for individual players to get an idea of how players respond to pressure. However, we find that these high-level metrics, like turnover percentage and pass completion percentage, lack context. To that end, we introduce the concept of Expected Threat (xT), as detailed here, to try and quantify the value of individual player actions. We use xT, and the related metric xT added, to evaluate player actions cumulatively and while under pressure. Finally, we use the distribution of normalized xT added metrics to rank players' passing abilities under pressure and their resiliency to pressure.

Data

For this report we used the freely available Open Data repository from StatsBomb found at https://github.com/statsbomb/open-data. This dataset contains 222 games of event level data from matches played in the FA Women's Super League 2018-19 season, the 2018 FIFA World Cup, and the National Women's Soccer League (NWSL) 2018 -19 season. We didn't include data from the 2019 Women's World Cup as this dataset is currently being updated. For more detail on how the data is structured and the attribute and event types captured, see https://github.com/statsbomb/open-data/tree/master/doc. Because this dataset contains a small number of matches and because we're focusing on player-level metrics, we combined all event data from each of these 222 matches into one dataset. For this analysis we focused on shots, passes, dribbles, and turnovers (resulting from incomplete passes/dribbles, miscontrols, and disposessions). In total, the event-level dataset we worked with contained 214,199 events from the three competitions specified above.

Descriptive Plots and Statistics

We're interested in how pressure affects player actions, and how players repond to defensive pressure. In this report we define an event as under pressure using the Boolean flag 'under_pressure' present in the StatsBomb event data. To begin, we look at where pressure events and turnovers are occurring on the pitch. We divide the pitch into 10x10 location bins, 12 along the length of the field and 8 along the width, resulting in 96 total bins. Figures 1 and 2 show the percentage of actions of interest (shots, passes, dribbles) that occur under pressure, and the percentage of actions that result in a turnover from each location. Note for all Figures in this report teams are attacking from left to right.

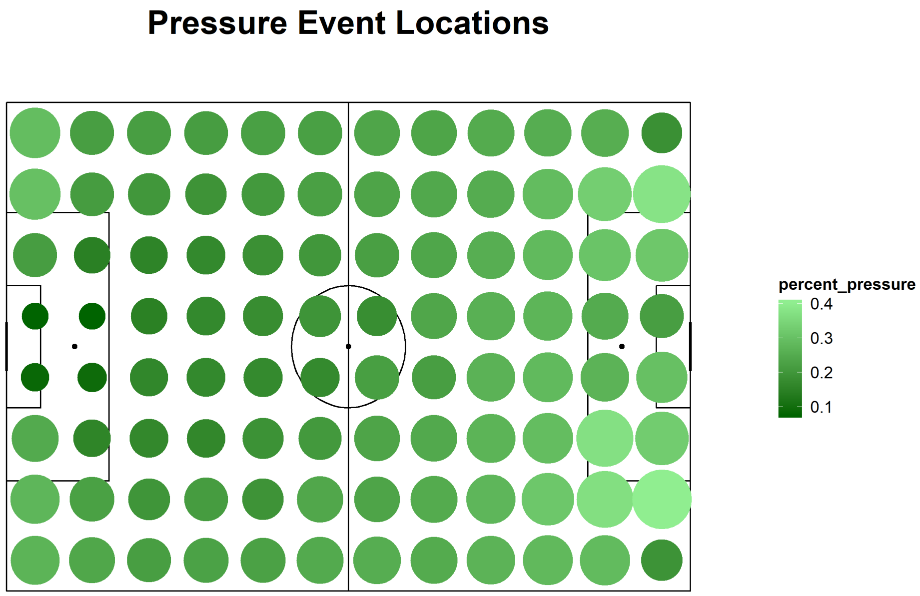

Figure 1: The percentage of actions that occurred under pressure from each of the 96 specified 10x10 location bins. Larger circles correspond to a higher percentage of actions pressured.

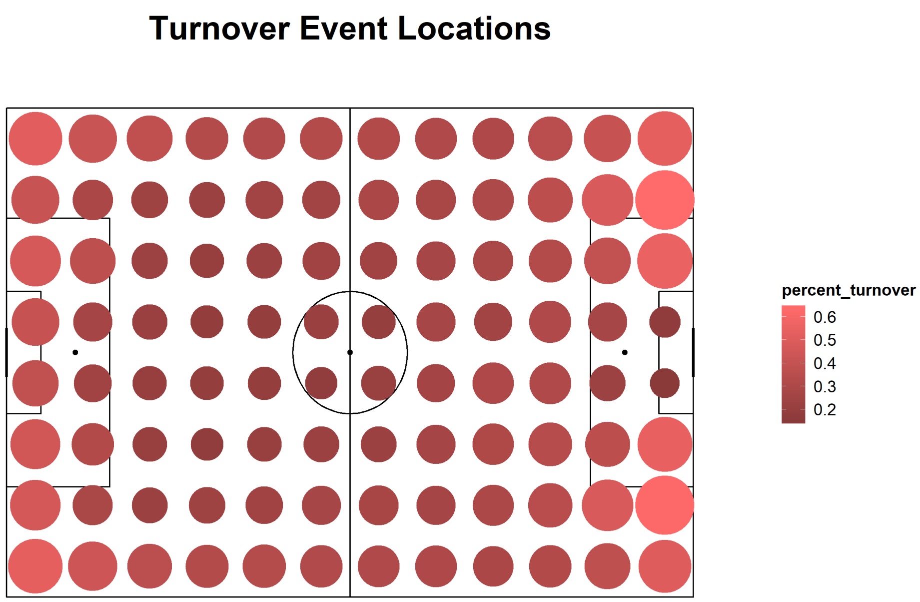

Figure 2: The percentage of actions that resulted in turnovers from each of the 96 specified 10x10 location bins. Larger circles correspond to a higher percentage of turnovers.

We can see that the majority of pressured events seem to occur along the wings, with the most pressured locations occurring near the edges of the 18-yard box when attacking. Actions occurring in the corners of the defensive end also seem to be pressured more.

Not surprisingly, we see the pattern of turnovers is similar to the pattern of action pressures. The percentage of events resulting in turnovers is high on the attacking wings, likely resulting from incompleted crosses. Turnovers are also high deep in the defensive zone, likely resulting from clearances.

Preliminary Player Metrics

We can start to look at when players are under pressure and how they perform under pressure using some preliminary cumulative metrics. We can calculate how often they're under pressure and their pass completion percentage and turnover percentage while under pressure. Examples of these plots can be seen below in Figures 3-5. These plots have been generated for three randomly selected backs, midfielders, and forwards.

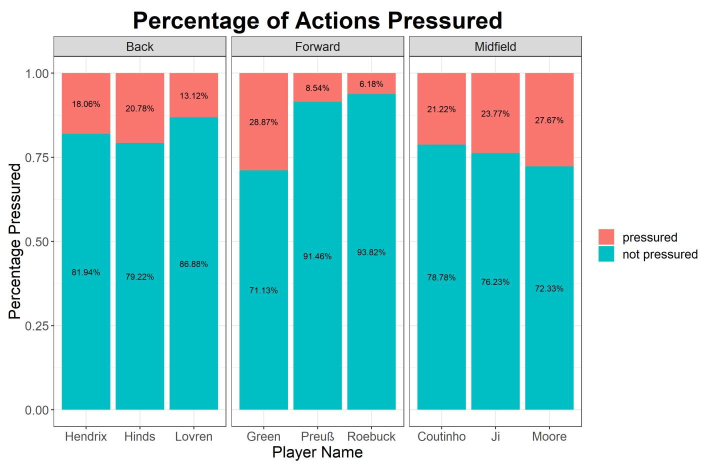

Figure 3: The percentage of actions pressured and not pressured for each player.

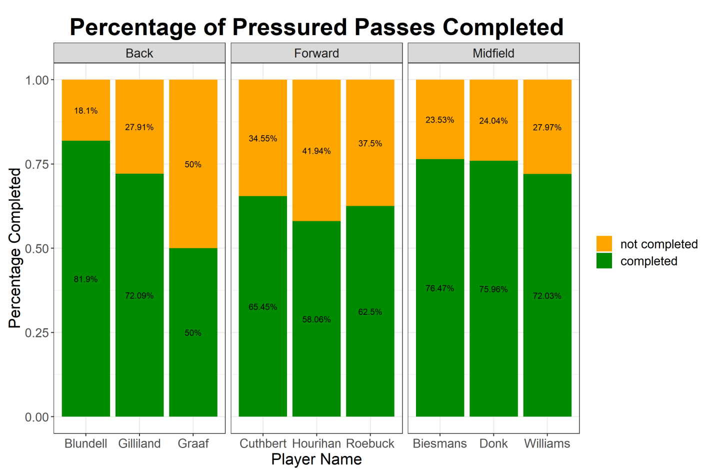

Figure 4: The percentage of passes that were completed while under pressure.

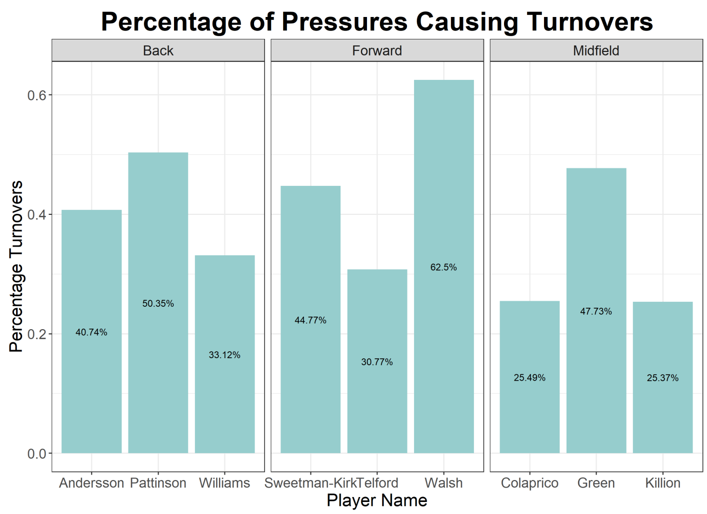

Figure 5: The percentage of pressured events that resulted in turnovers for each player.

While these plots give us some idea about which players are being pressured and how they're performing under pressure, they lack context. Players that are consistently attacking are going to turn the ball over more often. Additionally, it would be nice to see how players respond to pressure compared to when they're not being pressured. We can produce a couple more plots showing these relationships, seen below in Figures 6 and 7.

These plots give us a little more insight into how players are responding to pressure. For example, it seems that Abbey-Leigh Stringer responds moderately well to pressure in the defensive and midfield areas of the field, but pressure causes her to turn the ball over a lot in the attacking third. We could further breakdown these aggregate metrics. For example, we could combine Figures 6 and

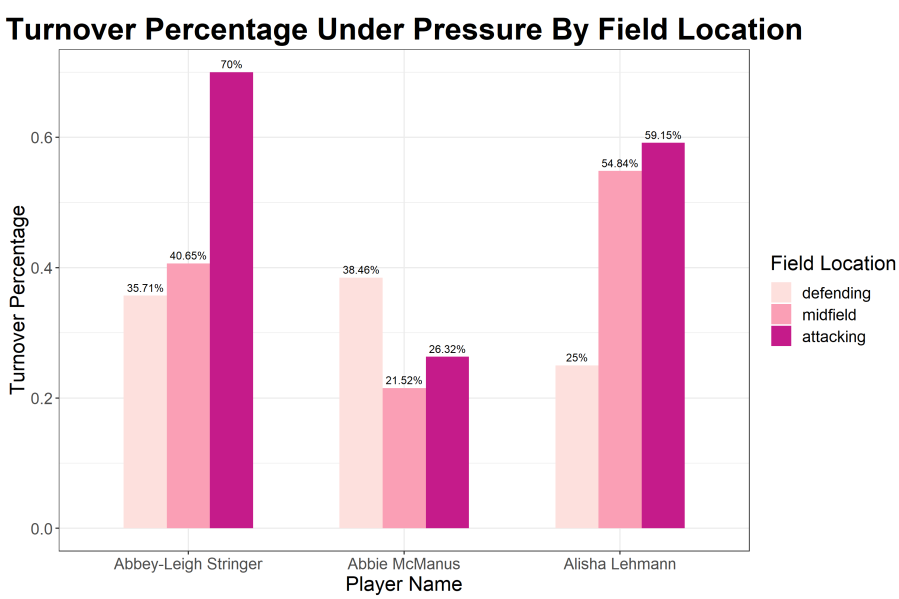

Figure 6: The percentage of actions resulting in turnovers for each player. Actions are separated based on their location into the defensive, midfield, or attacking third of the field.

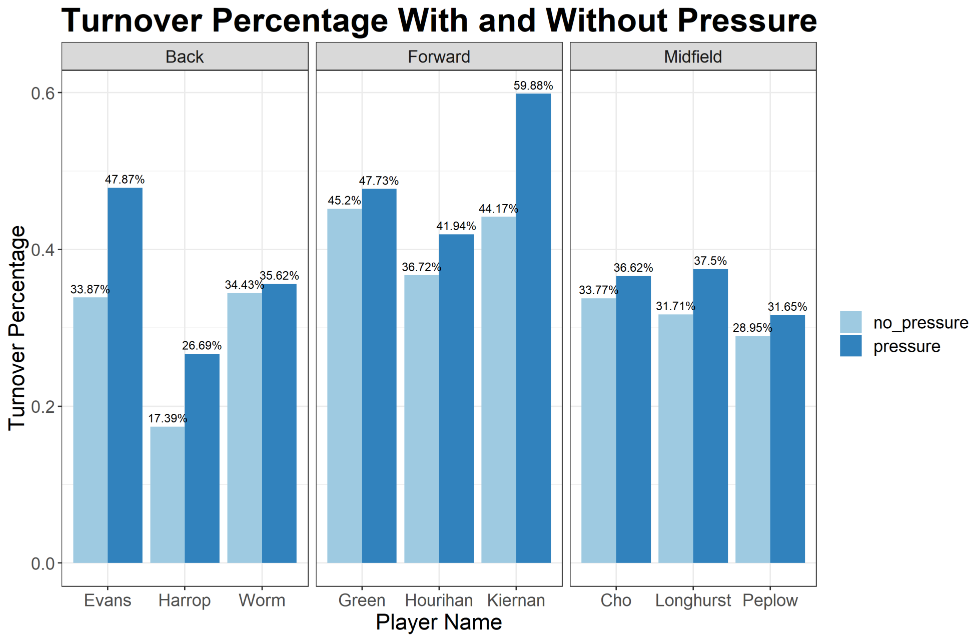

Figure 7: The percentage of pressured and unpressured events that resulted in turnovers for player.

7 and compare events with and without pressure within each third of the pitch. However, these metrics still lack context. Defensive pressure may cause players to make different decisions, and these aggregate metrics don't take into account the type of action being performed. We would like to differentiate players that are able to complete high-value actions under pressure vs. players that are more conservative. For example, if, when pressured, a player consistently passes the ball backwards, their pass and turnover percentages under pressure will be high, but they won't be creating threats on the opponent's goal. On the other hand, if a player is still able to complete crosses or dribble past players into dangerous areas while under pressure, even if on average this may lead to more turnovers, we would like to give more credit to those actions. In the next section we explore this idea by introducing the concept of Expected Threat.

Expected Threat

The Expected Threat (xT) metric we use to quantify the value of a given on-ball event is based on the blog post by Karun Singh seen here. This metric measures the probability of scoring a goal or moving the ball into a location where a goal may be scored during that possession. It attempts to quantify the threat of scoring a goal from any location on the pitch. Given some location (x, y) there is a probability of shooting from that location $s_{x,y}$ with a probability of that shot going in $g_{x,y}$. There is also a probability that the ball is moved to a different location $m_{x,y}$. Given our 96 10x10 grid locations, we can create a transition matrix $T_{x,y}$ containing the probability of moving to any of the other 96 locations. Thus we can define the xT metric for any location as the probability of scoring from that location plus a weighted probability of moving to another location on the field multiplied by the xT of the new location. This has the form

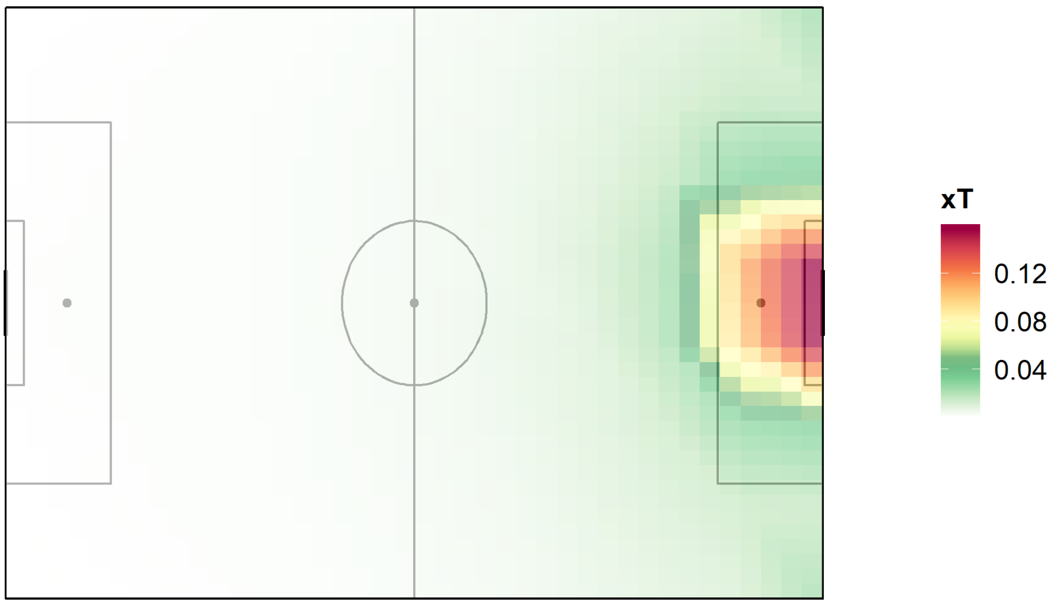

Figure 8: Visualization of Expected Threat (xT) for each location on the field. Interpolation was used to smooth xT values between the 96 10x10 location grids.

$$xT_{x,y} = (s_{x,y} * g_{x,y}) + (m_{x,y} * \sum_{i=1}^{96} T_{(x,y)\to(z,w)} * xT_{z,w})$$

This is the xT metric given by Singh. We amend this metric in our report to include turnover probability $t_{x,y}$, such that $s_{x,y} + g_{x,y} + t_{x,y} = 1$. We also use the average xG of shots in each location (as calculated by StatsBomb) as the probability of scoring, rather than the shot probability multiplied by the goal probability. Thus the xT metric we use has the form:

$$xT_{x,y} = (s_{x,y} * \frac{\sum_{j=1}^{n} xG_{(x,y)_j}}{n}) + (m_{x,y} * \sum_{i=1}^{96} T_{(x,y)\to(z,w)} * xT_{z,w})$$

In total, using the 214,199 events from the StatsBomb data, we obtain 96 xT values for each of our 96 specified locations. These values can be seen in Figure 8.

Using the calculated xT values from each location, we can now quantify the value added from moving the ball from one location on the field to another. Passes or dribbles that move the ball into higher xT areas can be rewarded more than passes that move the ball to lower xT areas. We can quantify the 'xT added' for each movement event as the xT value of the location where the pass/dribble ended minus the xT value of the origin of the pass/dribble. We calculate the xT added for each event as follows:

1. If action is a shot, the xT added is the xT value from the location of the shot.
2. If the action is a successful pass or dribble, the xT added is the difference in xT values between the start and end locations
3. If the action is an incomplete pass/dribble or a miscontrol/dispossession, the xT added is the negative xT value from the location where the turnover occurred.

The rationale for assigning a negative value to turnovers is that these cause teams to lose the value of the threat from their current possession. In the next section we aggregate xT values for players with and without pressure to try and determine which players are performing best under pressure.

Quantifying Actions Under Pressure using xT Added

We can now, using xT and xT added, quantify individual actions in buildup play by computing the difference in xT between the start and end point of those actions. This difference is essentially the change in probability a team has of scoring when moving the ball from one location to another. There are a variety of ways we can aggregate xT added for players to evaluate performance when facing pressure. We can simply sum their cumulative xT added values and compare these totals to when players are facing pressure, as in Table 1. We can also restrict this to different subsets of actions, for example to only completed passes and dribbles, as in Table 2.

Table 1: Cumulative xT added for all events (shots, passes, dribbles) and pressured events

Player Name	Position	Team	total xT	total xT pressure
Vivianne Miedema	Forward	Arsenal WFC	4.88	-2.0
Nikita Parris	Forward	Manchester City WFC	4.20	-0.911
Allie Long	Midfield	Seattle Reign	0.579	-0.131
Rachel Corsie	Back	Utah Royals	0.567	0.422

These tables show the players that are creating threats with high volume. We can also see how players change their decision making based on pressure. For example, it seems Vivianne Miedema creates a lot of high value threats when not facing any pressure, but when pressure is applied she is either playing conservatively or turning the ball over. By comparison, Rachel Corsie seems to consistently create threats, although fewer, both when pressured and unpressured.

While these tables are interesting, and do show the volume of threats created by players, we think a more interesting metric is xT added normalized by the number of actions taken. This allows us to see the average value of actions with and without pressure, and compare the difference. Since

Table 2: Cumulative xT added for all completed passes/dribbles and pressured completed passes/dribbles

Player Name	Position	Team	total xT	total xT pressure
Bethany Mead	Forward	Arsenal WFC	5.38	0.0611
Karen Carney	Forward	Chelsea LFC	4.99	0.252
Caroline Weir	Midfield	Manchester City WFC	4.62	-0.206
Fara Williams	Midfield	Reading WFC	4.41	0.186

pressured events occur less frequently, comparing averages allows us to directly see changes in action results and decision making for each player. It also allows us to compare players who've played different amounts. Table 3 and 4 repeat the same calculations as Tables 1 and 2, but this time normalize totals by the number of actions taken.

Table 3: Average xT added for all events (shots, passes, dribbles) and pressured events

Player Name	Position	Team	avg xT	avg xT pressure
Francesca Kirby	Forward	Chelsea LCF	0.00758	-0.000707
Samantha Kerr	Forward	Chicago Red Stars	0.00617	-0.00224
Jessica McDonald	Forward	North Courage	0.00612	0.00507
Jordan Nobbs	Midfield	Arsenal WFC	0.00604	0.00272

Table 4: Average xT added for all completed passes/dribbles and pressured completed passes/dribbles

Player Name	Position	Team	avg xT	avg xT pressure
Karen Carney	Forward	Chelsea LFC	0.0139	0.00265
Bethany Mead	Forward	Arsenal WFC	0.0109	0.000437
Claire Emslie	Forward	Manchester City WFC	0.0101	0.000869
Megan Rapinoe	Forward	Seattle Reign	0.00954	0.00688

Under the xT framework, these average xT added calculations are the average change in goal probability for a given action. For example, completed passes and dribbles by Claire Emslie, on average, increase her team's probability of scoring on that possession by 1.01%. We can compare these average xT added numbers for each player to see which players perform overall and under pressure. We can also see the magnitude of the effect pressure has on each player.

Finally, we can use the distribution of average xT added metrics to rank players. We can compute a rank from 1-10 based on the percentile where a player's xT added metrics fall. Below we've computed the rank for each player on Arsenal WFC for their avg xT added under pressure on completed passes/dribbles and their rank for their resiliency to pressure based on the difference in avg xT added between pressure and non-pressure events.

Table 5: Ranks of Players on Arsenal WFC for Passing/Dribbling Ability Under Pressure and Resiliency to Pressure

Player Name	Position	Team	Passing/Dribbling Rank	Resiliency Rank
Bethany Mead	Forward	Arsenal WFC	4	3
Vivianne Miedema	Forward	Arsenal WFC	1	6
Jordan Nobbs	Midfield	Arsenal WFC	8	9
Kim Little	Midfield	Arsenal WFC	8	3
Danielle van de Donk	Midfield	Arsenal WFC	9	4
Katie McCabe	Back	Arsenal WFC	4	2
Katrine Veje	Back	Arsenal WFC	10	7
Lisa Evans	Back	Arsenal WFC	9	8
Dominique Bloodworth	Midfield	Arsenal WFC	10	8
Lia Wälti	Midfield	Arsenal WFC	4	5
Emma Mitchell	Back	Arsenal WFC	2	7
Leah Williamson	Back	Arsenal WFC	5	5
Louise Quinn	Back	Arsenal WFC	4	4
Pauline Peyraud Magnin	Forward	Arsenal WFC	5	4

Future Work

These are a few of the possible ways to use xT and xT added to evaluate players under pressure. We can continually add more context to these metrics to hone in on specific areas, like specific field locations or certain actions like crosses, to get a better idea of how players perform specific actions while pressured. We can also look at how the duration of pressure affects xT added metrics, or how xT changes over the course of a possession based on which actions are pressured. Additionally, these metrics may be used in the context of scouting or recruiting. We can create team specific xT and pressure maps and look at whether players tend to create high xT actions in a particular team's style or whether players respond well to the type of pressure that certain teams come under.