Is shot quality consistent over time and across players?

Usage of analytics in football has seen great strides over the past decade, with much of the progress seen as a result of the innovation that is expected goals. Expected goals (xG) provides a singular value which captures a snapshot of the quality of the chance when the ball is struck towards goal, by showing the probability of scoring from that position. These models take into account ball positioning, type of shot, positioning of defenders and more factors (particularly the more advanced models produced by the likes of statsbomb) to quantify chances. Figure 1 gives a very simple overview of how xG works, where shots which are taken closer to the goal and at a more perpendicular angle have better chances to go in, with some exceptions being seen where, for instance, the goalkeeper may be out of position and the proximity of the defenders when the ball is hit. Although the quality of a chance itself is very useful information to evaluate performance, this article will delve further into a different aspect of the chance, that being the quality of the shot itself.

Figure 1

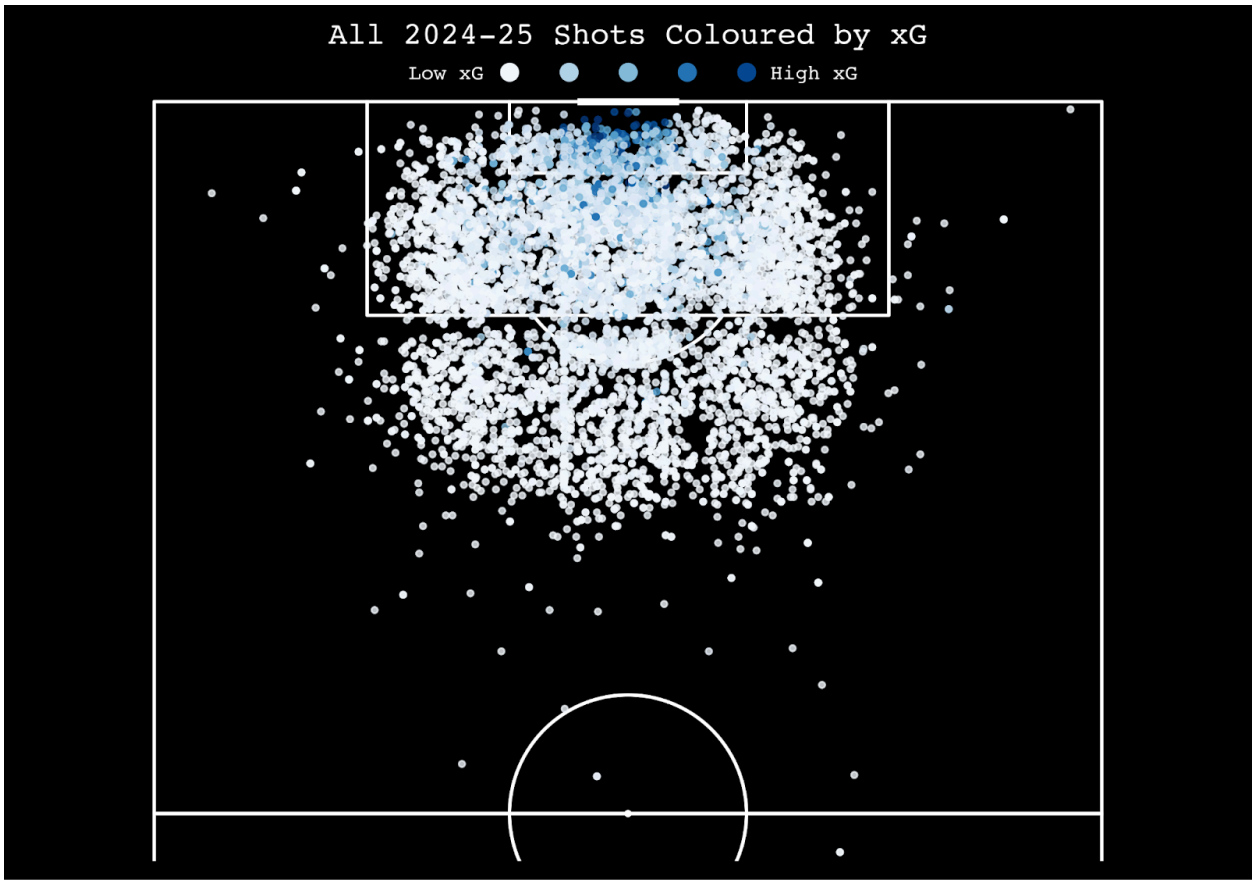


Figure 2 shows a picture of a goal overlaid with shots taken in the current Premier League season coloured by their post-shot expected goals value (PSxG, sometimes referred to as expected goals on target). PSxG acts to evaluate the probability of the shot going in after being hit based on the position it crosses the goalline, the angle of the shot, thedistance the shot is

taken from and particularly the speed of the shot. Figure 2 generally shows that shots have better chances of going in when placed towards the corners, but other factors such as shot velocity explain much of the variation that can be observed. Therefore a very simple way of creating a measure of shot quality is how much does a player improve their chance of scoring from the point where they are about to shoot to after they have taken the shot, seen by PSxG minus xG.

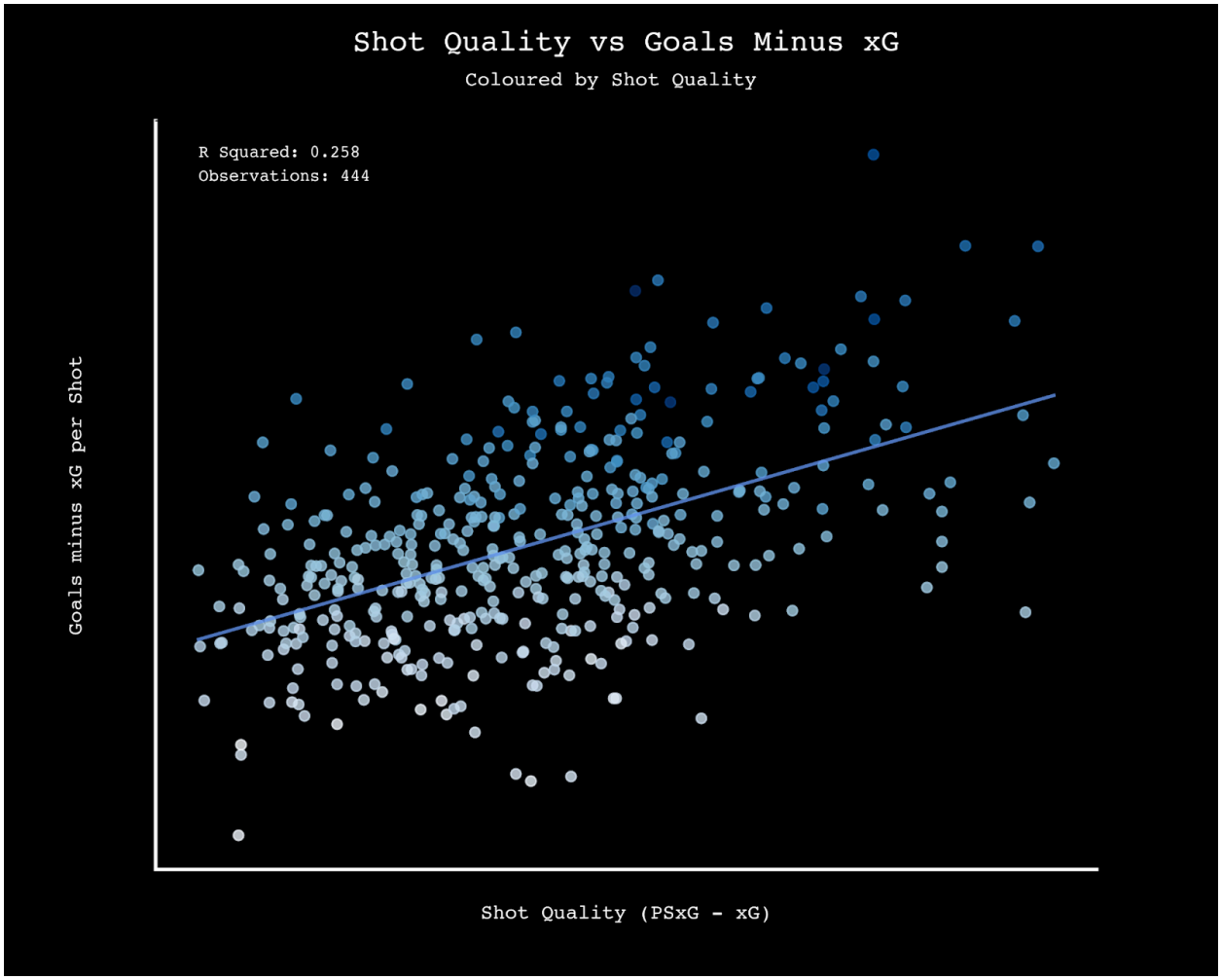
Figure 2

Comparing xG and PSxG is the most simple method of shot quality evaluation that will be explored in this article and will be the main method to observe differences in shot quality between players and across time, partly due to the abundance of data. The second method will look at a more experimental way of measuring shot quality. This method will try and compare the shot to the average shot in a specific zone of the goal and whether they improved their chance of scoring to that average. This would consequently measure if players are better at placing the ball and have better shot accuracy than others.

Why is shot quality important to look at?

Shot quality's importance boils down to the fact it is indicative of a player's ability to outperform their expected goals value, hence allowing them to score more and improve their team's chances of winning. This relationship can be seen on a shot-by-shot basis in figure 3 which compares a players shot quality per shot (PSxG minus xG) for the season to their goals minus expected goals per shot value for the same season. Figure 3 shows a positive relationship between the two variables. Through running a linear regression which returned a 0.258 R-squared value, shot quality had a 0.000 p-value, suggesting a players ability to outperform their expected goals value is a result of better shot quality, which is backed up by the positive relationship in figure 3. Now we can see that better shot quality is beneficial to player performance, it poses the question of if shot quality is something that players are able to control, hence making them potentially more valuable than other players.

Figure 3



Another way to try quantifying shot quality

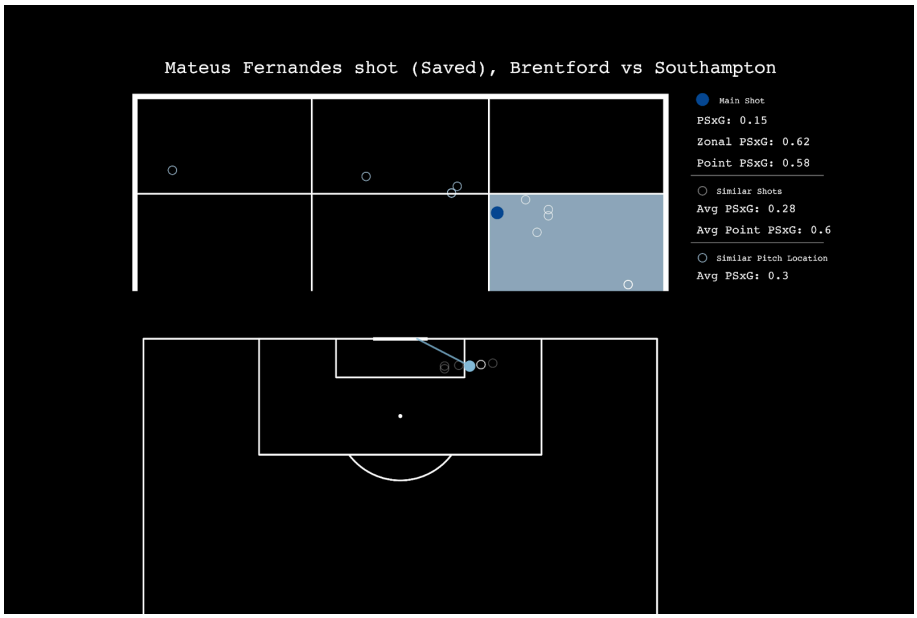
It is interesting to try and look one step further into shot quality using the data that is available, by creating a shot quality metric which is constructed around the position of the shot in the goal and players' shot accuracy. Although this idea lacks the fairly key component to PSxG that is the speed of the shot, it will work to compare two similar metrics which in turn will emphasise the difference between the numbers rather than the numbers themselves. Even though this assumption isn't necessarily accurate, this method will use the assumption that footballers hit the zone of the goal they are aiming for when taking a shot, breaking the goal into six different zones, between thirds of its width and top/bottom. The metrics will then evaluate how a player

improves their chances of scoring by placing the ball well in the zone rather than just in the zone itself.

By using logit regression I have created two different metrics that, at their roots, are less advanced PSxG models. The difference between the two models is that one uses only the zone of the goal to dictate the movement of the ball, whereas the other also incorporates the exact point the ball crosses the goal line. The theory behind this is that the “Zonal PSxG” model gives an overview of how likely that shot was to go in by an average professional footballer aiming at that zone, whereas the “Point PSxG” should provide a slight difference which suggests how much the players shot accuracy helped or hindered their chance of scoring.

An example of how this method works can be seen in figure 4, this shows an example of a shot by Mateus Fernandes against Brentford. The official PSxG, of course containing much more information and training off a larger dataset, deems the shot to have a 15% chance of going in. The difference between the Zonal PSxG and Point PSxG suggest that the positioning of Fernandes’ shot reduced his chances of scoring compared to other shots which have been taken at that angle and aimed at that zone. By looking at figure 4 this would make sense as the ball is placed towards the centre of the goal and at a comfortable height for the keeper to save the ball. The detriment to the probability of scoring can further be seen when comparing the shot to some taken at a similar place, which were deemed to have a higher PSxG on average at 28%, but also a higher Point PSxG value. The third option shown on Figure 4 is the average PSxG value of shots which hit outside the zone that Fernandes shot at, which have a higher PSxG value on average as well, possibly suggesting that it would have been beneficial for Fernandes to shoot in a different place.

Figure 4



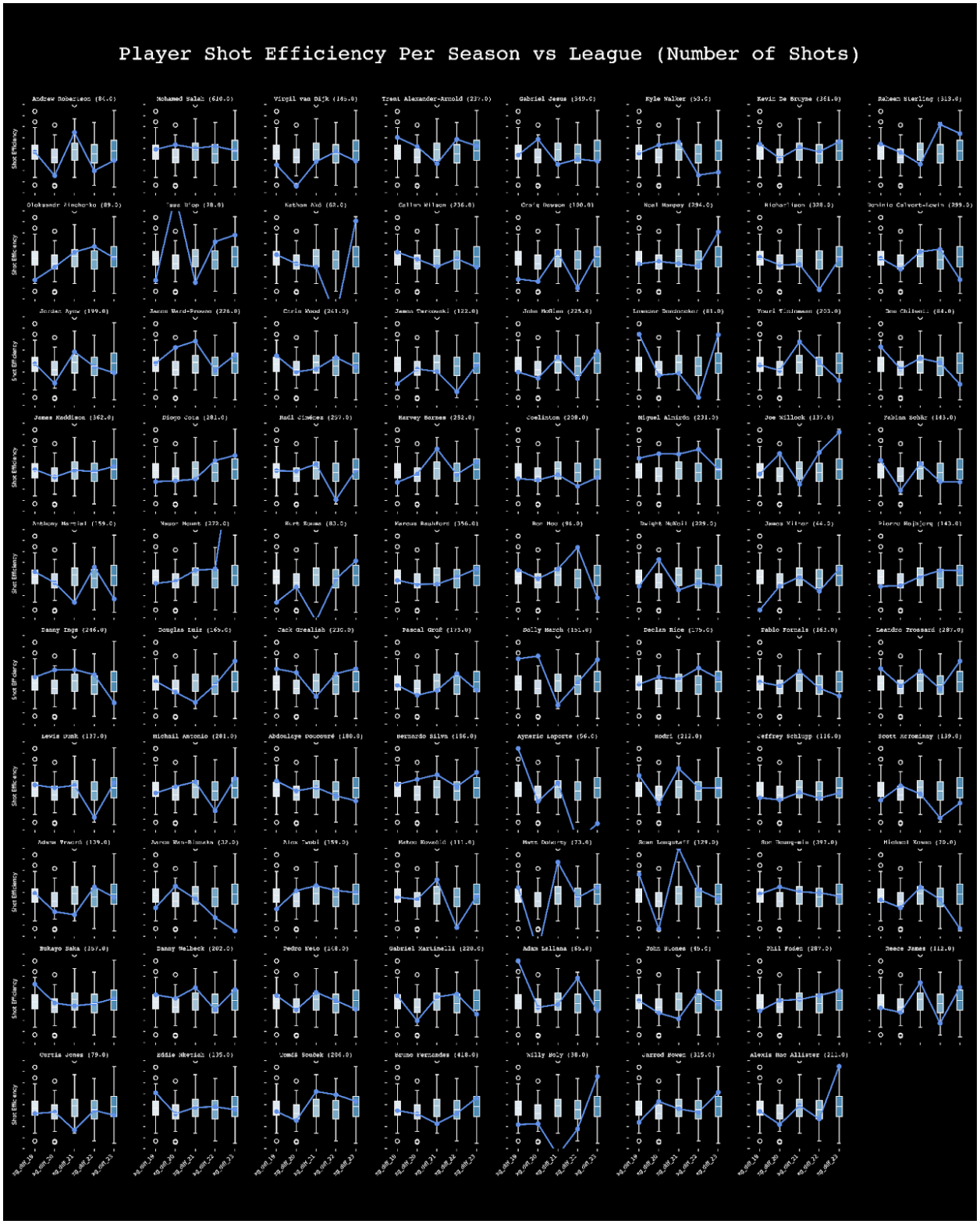
Despite this being an interesting method and attempt to draw insight from how accurate players are at shooting, the simplicity of the PSxG models that are being trained have resulted in the metrics having poor predictive power and therefore use in evaluating players. Running linear regressions between this shot quality metric (Point PSxG minus PSxG) and ability to outperform expected goals, yields no correlation between the two, hence in the shot quality metric's current form it is not useful. With a more accurate model it may have some use, but would need extensive testing to provide an answer.

A better method to evaluate shot quality would be to take the professional PSxG models and look at how the values would change if the player had shot the ball at a different place. This would allow you to evaluate how close to the optimal shots players take (proximity to maximising chances of scoring) and how they may improve decision making in future, similar, situations.

Is shot quality consistent over time and players?

Let's return to using PSxG minus xG as the best measure we have of shot quality and turn to the main question as to whether players have control over this quality between themselves and over time. Figure 5 gives a fairly good representation of how shot quality changes across the league, between the two variables. For the seventy-nine, players that played in the Premier League for the five seasons from the 2019/20 season to the 2023/24 season, each contains a set of box plots showing the spread of shot qualities for the respective season, overlaid with a line graph showing the shot quality for the respective player. Even though some variation can be attributed to small sample size in some particular season, there is clearly little consistency over time for the majority of players, shown by the large swings of the line graphs. This is further backed up by running a linear regression to compare how good a predictor previous year shot quality is for the next year. With an R-squared value of 0.008 and p-value of 0.118 this further suggests that there is no relationship over time, and previous season shot quality does not dictate that of the next season.

Figure 5


Player Shot Efficiency Per Season vs League (Number of Shots)
Andrew Robertson (84.0)
Mohamed Salah (610.0)
Virgil van Dijk (146.0)
Trent Alexander-Arnold (237.0)
Gabriel Jesus (349.0)
Kyle Walker (53.0)
Kevin De Bruyne (361.0)
Raheem Sterling (313.0)
Oleksandr Zinchenko (89.0)
Cole Palmer (38.0)
Nathan Aké (62.0)
Callum Wilson (756.0)
Craig Dawson (100.0)
Neal Maupay (394.0)
Richarlison (338.0)
Dominic Calvert-Lewin (399.0)
Jordan Ayew (199.0)
Aaron Ward-Prowse (228.0)
Chris Wood (241.0)
Jamaal Lascelles (122.0)
John McGinn (225.0)
Ivan Toney (81.0)
Youri Tielemans (203.0)
Ben Chilwell (84.0)
James Maddison (362.0)
Diogo Dalot (281.0)
Rúben Dias (297.0)
Harvey Barnes (252.0)
Coutinho (208.0)
Miguel Almirón (231.0)
Joe Willock (137.0)
Fabian Schär (143.0)
Anthony Martial (159.0)
Mason Mount (372.0)
Kurt Zouma (83.0)
Marcus Rashford (356.0)
Ben Mee (96.0)
Dwight McNeil (339.0)
James Milner (44.0)
Pierre Højbjerg (143.0)
Danny Ings (246.0)
Douglas Luiz (169.0)
Jack Grealish (230.0)
Pascal Groß (173.0)
Solly March (151.0)
Declan Rice (179.0)
Pablo Fornals (162.0)
Leandro Trossard (287.0)
Lewis Dunk (137.0)
Michail Antonio (281.0)
Abdoulaye Doucouré (180.0)
Bernardo Silva (186.0)
Aymeric Laporte (56.0)
Rodri (212.0)
Jeffrey Schlupp (116.0)
Scott Arfield (139.0)
Adama Traoré (139.0)
Aaron Wan-Bissaka (32.0)
Alex Iwobi (159.0)
Mateo Kovačić (111.0)
Matt Doherty (73.0)
Sean Longstaff (129.0)
Joe Bryan (397.0)
Michael Keane (79.0)
Bukayo Saka (257.0)
Danny Welbeck (202.0)
Pedro Neto (168.0)
Gabriel Martinelli (220.0)
Adam Lallana (85.0)
John Stones (45.0)
Phil Foden (287.0)
Reece James (112.0)
Curtis Jones (79.0)
Eddie Nketiah (135.0)
Tomáš Souček (206.0)
Bruno Fernandes (418.0)
Willy Boly (38.0)
Jarrod Bowen (315.0)
Alexis Mac Allister (211.0)
Shot Efficiency
xg_diff_19
xg_diff_20
xg_diff_21
xg_diff_22
xg_diff_23

In terms of looking across players there is seemingly similar randomness. A few players can be seen to be fairly consistently above the median on the box plots, such as Mo Salah (row one, column 2), Son Heung-Min (row 8, column 7) and in particular Miguel Almiron (row 4, column 6) who had a run of performing above the 75th percentile for the first four years of data. This lack of consistency does possibly suggest that players may experience regression towards the mean over time when outperforming their expected goals, which is what you'd hope to expect. The quality of players therefore comes down to their ability to get into positions that would maximise their xG and then further maximise their shot quality where they can. Although there is no data to check, higher shot velocity likely would lead to better PSxG (if the shot is on target) as well as placement of the shot which are inherently some players can be better at than others.

Figure 6 gives a final overview at the top five and bottom five individual seasons by shot quality (filtered by at least 50 shots, for the interest of seeing Ronaldo at the bottom). An interesting player to make a note of is the 2021/22 James Ward-Prowse season, this is because 23 of his 51 shots were from free-kicks. As a player praised for his set-piece ability, Ward-Prowse was likely able to leverage these traditionally low xG free-kicks, to more often have shots on target and raise the PSxG value. This gives an example of how shot quality can vary across players on a more consistent basis, but in open play it still seems to have large variability. If these players shot quality was to regress towards the mean all ten of them could have been seen to have very different seasons.

Figure 6

Top Five and Bottom Five Individual Seasons by Shot Quality

Player	Season	xG Diff	Shots	Goals - xG	Goals - xG/Shot
Conor Gallagher	21	0.1	52.0	1.6	0.031
Alexander Isak	23	0.099	72.0	0.26	0.004
Alexandre Lacazette	19	0.098	52.0	1.33	0.026
Sadio Mané	19	0.095	77.0	4.31	0.056
James Ward-Prowse	21	0.094	51.0	3.81	0.075

Player	Season	xG Diff	Shots	Goals - xG	Goals - xG/Shot
Cody Gakpo	23	0.018	66.0	-0.94	-0.014
Stuart Armstrong	20	0.017	55.0	1.33	0.024
Saïd Benrahma	22	0.015	69.0	-1.86	-0.027
Dominic Calvert-Lewin	23	0.015	71.0	-6.36	-0.09
Cristiano Ronaldo	21	0.015	107.0	-0.75	-0.007

Conclusion

Shot quality does appear to be a useful metric to help analyse chances more than to analyse players. It does seem to possess the ability to allow shots to outperform their expected goal value but in this current simple way to look at it does not appear to be consistent across players over time. This does, however, open up the possibility for a better shot quality metric to be made, possibly building off the ideas of Zonal PSxG and Point xG but requiring more and better data, as well as likely more proven concepts to help evaluate player performance. Improving upon these metrics could lead to players making better decisions while shooting, which could make this more consistent. Finally, stripping the idea of shot quality back further into optimal ball location and ball velocity, suggests that a path along those lines could also provide interesting insight into shot quality, which could be quantified in the same way as the probability of a goal being scored.