Modeling Kick Return Outcomes by Field Control & Cutbacks

How can making reads during kick returns can net more yards.

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Project Motivation and Data Description

While many coaches acknowledge the importance of special teams, it remains a challenge to invest similar resources in this brief but consequential component of play. It seems that the current approach is scheme what you can and focus on making big defensive plays, rather than big return plays. From the 2018 – 2020 seasons in across all special teams plays there were more forced fumbles than touchdowns. There are 3 primary outcomes to a kickoff, touchback, fair catch, and a return. The last thing you want after forcing a 3rd down stop or setting up after your opponent just scored is to give the ball right back to them. For this reason we see most returns ending with fair catches. There is nothing quite like seeing a return man making a big run or bringing one home for six. But how can we convince players, and coaches, that these risks are ones we should be willing to take. The answer can simply be a consistently getting field position that is better than the 25 yard line. A ball kicked out of the endzone generates a touchback that always has a 25 yard line start, a fair catch is a ball that is caught in the endzone and was decided to not be returned, also generating a 25 yard line start, and a return designates a start point and an end point, the offense starting at whatever that end point was.

Returners make several decisions to when fielding a kick: whether to bring it out of the endzone, initial direction, and whether they want to deviate from that direction. Kickoff returns are typically designed to create alleys. In Figure 1, we see the 1 and 2 being blocked near the boundary, and the 3, 4, and 5 being blocked more towards the field. This creates an alley for the returner to run through. Another thing that could happen is the alley could get clogged by players from both teams, forcing the returner to bounce towards the sideline.[1]

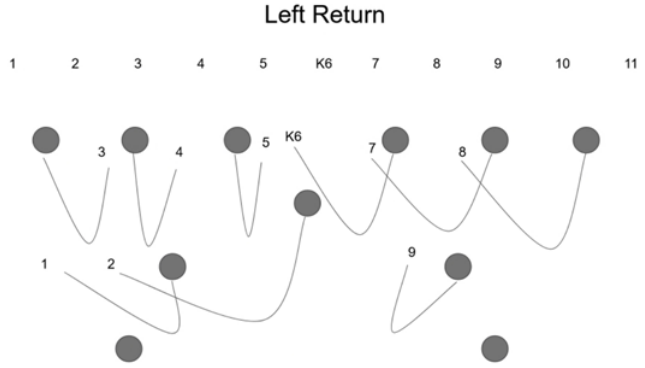

Figure 1: 2-Returner formation towards the left.

Following our blockers here can lead to more consistent returns, but could we get more yards if we decide to cutback? My objective is to find whether there is a difference is in staying on the side you received the ball, following your 1st level blockers and gapping your 2nd level up the alley, or bouncing outside towards the sideline.

To answer this question we had tracking data for every special teams play from the 2018 – 2020 seasons. There were a total of 7,843 kickoffs, of those 4,773 were touchbacks (just over 60%),

[1] Credit to Sam Fleener of PHS Football for the Diagram

and only 2,724 were returned. To be consistent with our analysis of the decision to cross the field we have removed instances of slight crossing, for example catching the ball 1 yard to the left of the field midline and running 1 yard to the right of the midline, would count as a cutback and crossfield run, but it is practically a same-side run. To account for this, we removed any return that was caught in between the hash marks. After removing plays that had fumbles, muffs, laterals, short kicks, we end up with 2,184 normal deep kick returns

The tracking data supplied by the NFL has positional, directional, and movement data of every player on the field at 10 instances (frames) per second for the entire play. While many tracking data projects deal with situational play calling; for example probability of converting a 4th-and-1 on our 45. We will incorporate situation here by using score differential rather than down and yards to gain. We have noticed that teams are more likely to attempt kick returns when they are losing. This is important to take note since teams are willing to take more risks when they are losing. To work with the tracking data, it had to be standardized to make all returns go in the same direction. This required adjusting location coordinates, angles, acceleration/speed vectors.[2]

Significance Testing of Return Types

First, we must see if there's a difference in receiving the ball on the left side or the right side of the field, because if there is then we can assume there will also be a difference down field due to how blocks develop, and standard gunner pathing and point of arrival. Shown below in Figure 2, we can see there is a difference in quantiles, but more importantly the 50th percentiles of receiving on the left side of the return is about 3 yards less than receiving on the right side. In Figure 3, we see that the 50th percentiles are equal, but there is a wider spread among the 25th – 75th percentiles. This leads us to believe that the is higher variance in yardage when we are attempting a cutback and crossfield play, and potentially a difference in means.

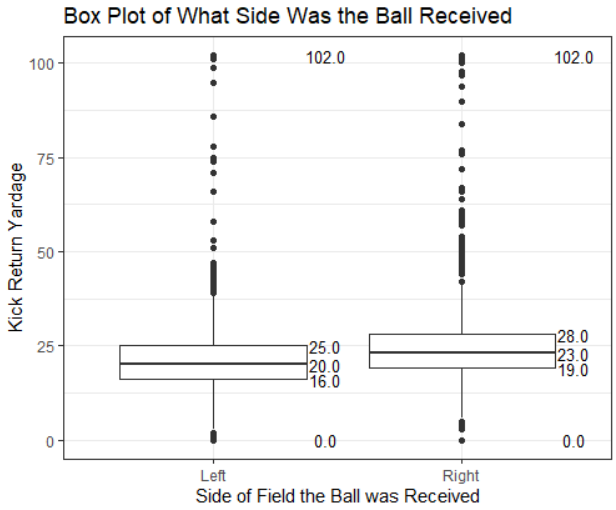

Figure 2

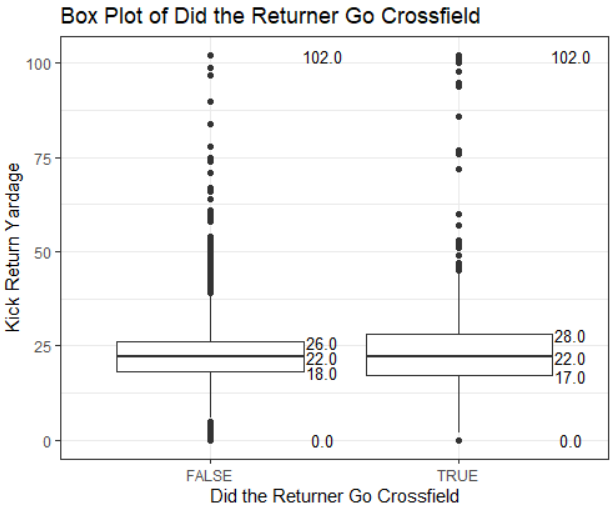

Figure 3

[2] Credit to Michael Lopez for the standardization code

To find if there is a difference in outcome depending on which side of the field the ball is received on, we will conduct a 2 sample t-test for a difference in means.

$$H_o: \mu_1 = \mu_2$$

$$H_a: \mu_1 \neq \mu_2$$

There was a significant difference in the return yardage starting on the left side of the field (n = 1068, $\mu_1 = 21.36$, $\sigma_1 = 9.89$) and the return yardage starting on the right side of the field (n = 1116, $\mu_2 = 24.44$, $\sigma_2 = 11.18$) conditions; t-crit = 6.83, p-value = <.001, 95% CI (-2.20, -3.97). These results suggest that there is a difference in means, and we are 95% confident that a return from the left side of the field will yield 2-3 yards less than a return from the right.

To find if there is a difference in outcome depending on whether the returner cutback and crossed field, we will conduct a 2 sample t-test for a difference in means.

$$H_o: \mu_1 = \mu_2$$

$$H_a: \mu_1 \neq \mu_2$$

There was a significant difference in the return yardage starting when the returner did not cross field (n = 1761, $\mu_1 = 22.46$, $\sigma_1 = 14.48$) and the return yardage when the returner crossed field (n = 423, $\mu_2 = 24.44$, $\sigma_2 = 9.49$) conditions; t-crit = -3.29, p-value = <.001, 95% CI (-3.89, -0.98). These results suggest that there is a difference in means, therefore we will reject the null hypothesis in favor of the null.

When looking at a table of the of means of side fielded against crossed field in Figure 4, we see that for both sides on average it returns net more yards when going crossfield. In general on average, we see that accomplishing a crossfield play nets the return more than if they stayed on the same side.

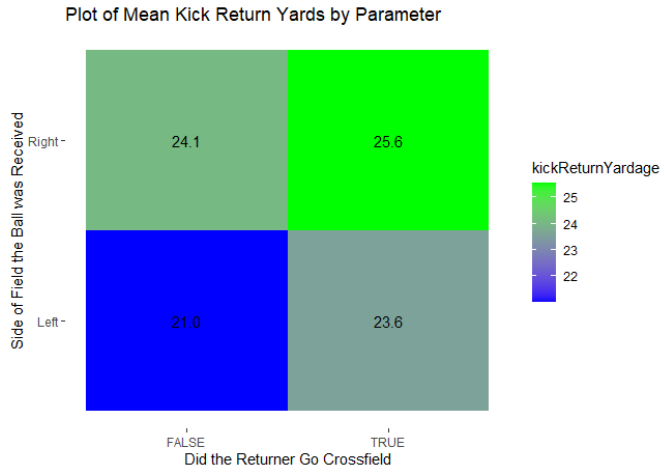

Figure 4: Chart of Mean Kick Return Yards relative to their conditions

The simplest way to see the best direction is to go is by finding the angle of the initial catch and draw a straight line from return start to return finish. We designate a successful return by if they return the ball to at least the 25 yard line. From the sonars in Figure 5 we see can see that going straight is not necessarily the best way to go. We see the highest success on average going towards the middle of the field. Left side specific, we see a low success rate when the returner ends up toward the sideline.

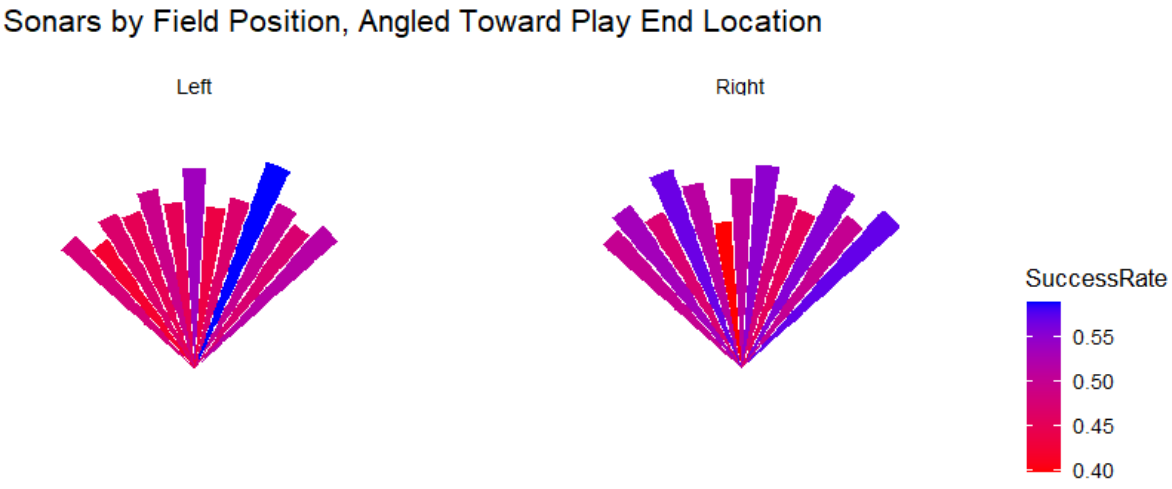

Figure 5: Sonar of each side of the field, color scaled by success Rate

Field Control

To compute field control, I used the player influence formula developed by Javier Fernandez and Luke Bornn.[3] Player influence is determined by Gaussians centered in a player's direction of motion.

In Figure 6 and Figure 7, we see two return by Jakeem Grant by roughly the same starting area .3 seconds after the catch, but with 2 different outcomes. In the first play, Grant reads the mass of people in front of him and decides to cutback where he has a blocker on the 11 man and can sprint by for a touchdown. In the second play, we see Grant dart towards the sideline, and into an unblocked man and additional traffic. Had he decided to go to open field (in front or to the right) he may well have gotten more yards.

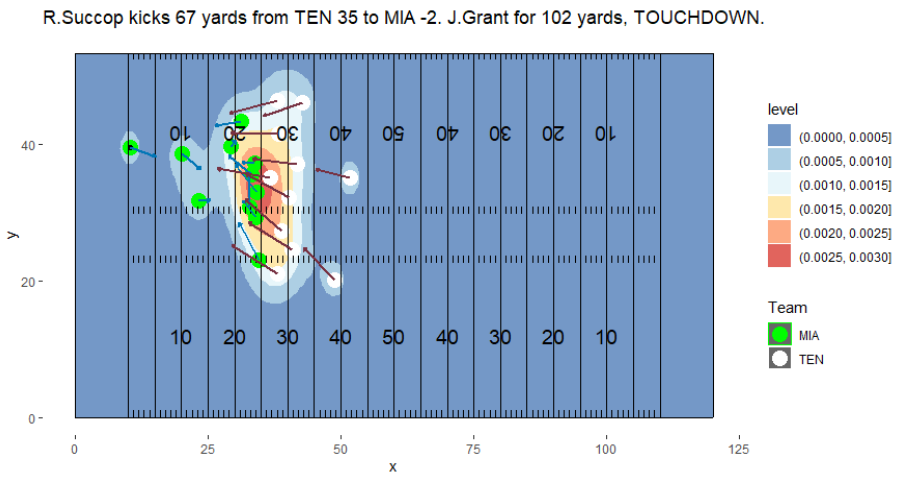

Figure 6

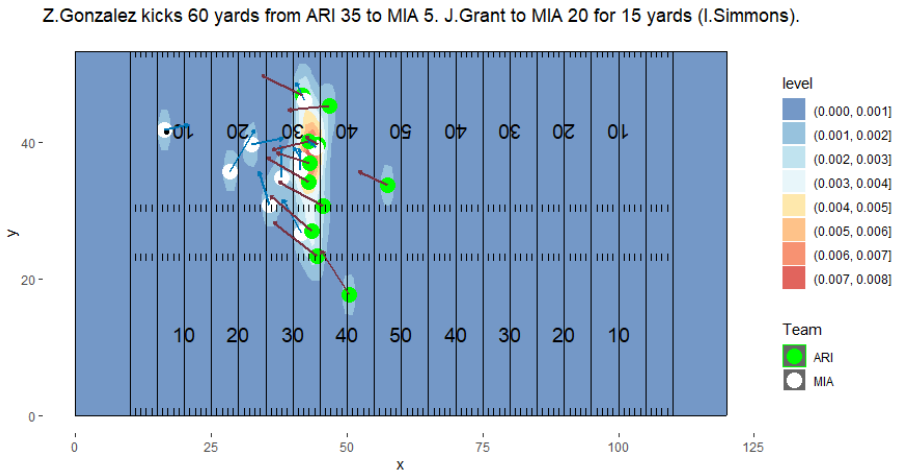

Figure 7

[3] A more in-depth explanation can be found in Fernandez, Javier & Bornn, Luke. (2018) Wide Open Spaces: A statistical technique for measuring space creation in professional soccer

Modeling Kick Returns

The three situational predictors used are score differential, what side the ball was caught on, and whether they cutback. Acceleration and Field Control metrics are included.

These are the predictors used:

- S, game score differential (Return Team Score – Kick Team Score)
- S_r, Side of the field the ball was received on
- I_c, Boolean of Crossing field or not
- a, acceleration of the Returner
- FC_1, Field Control of the Returner
- FC_2, Highest Field Control on the Kickoff team
- d_1, Distance of the Kickoff team player with the highest Field Control
- d_2, Distance of the Returner to the 25 yard line
- y, the yards returned

$$y = \beta_0 + \beta_1 S + \beta_2 S_r + \beta_3 I_c + \beta_4 a + \beta_5 FC_1 + \beta_6 FC_2 + \beta_7 d_1 + \beta_7 d_2$$

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	16.95170	2.70188	6.274	>.001 ***
S	-0.03369	0.02143	-1.572	0.11605
S_{r_Right}	1.21139	0.42809	2.830	0.00470 **
I_{c_true}	1.46690	0.53134	2.761	0.00582 **
a	-0.19071	0.19205	-0.993	0.32081
FC_1	-74.91479	50.20205	-1.492	0.13577
FC_2	-146.25514	29.46031	-4.964	>.001 ***
d_1	0.41608	0.05218	7.974	>.001 ***
d_2	0.36962	0.05406	6.837	>.001 ***

Table 1: Regression Outputs, Adjusted $R^2 = 0.185$

We see starting location, crossing, highest field control of the nearest opponent, and their distance to the ball, and distance to the 25 yard line to be the highly significant. It is interesting to see FC_1 and acceleration to not be significant at least at a .05 level, perhaps snapshotting a few additional frames into the play we would see differently results.

Conclusion, Recommendations, and Future Work

I believe kick returns could be a similar process to inside zone reads on offense. A common concept used in zone reads is bang, bounce, or bend. When the center is able to climb downfield and hit their block, the running back will bang (hit the designed B gap, usually a straight line). When the LB is not blocked downfield the RB can make the read to bounce outside, or cutback and bend inside. This is all based off a read from blocking leverage. Our stat testing and modeling results have implied that bending could lead to longer returns. Currently, the kick return meta is to either bang or bounce. By encouraging returns to bend or cutback we can play with much more of the field, and by staying away from the sideline, we deny the defense from using it as another defender.

My recommendation is a philosophy change. Let's deviate from following our blockers and bouncing outside, instead let's read some players downfield. Specifically our returner would be reading the 1, 2, 10, and 11 (L1, L2, R1, R2). The 1 and 11 are responsible for floating down the sideline to work contain until the football is being returned. Return teams typically don't assign blockers to the outmost player (1 or 11) shown in Figure 1, but I am proposing that we attempt to block them given an opportunity to attack open space. The only way to get better at making these reads is to practice full kickoff drills and have guys looking for space and practicing reading bodies down field.

There are many decisions a returner must make when fielding a kickoff return. Further work I would want to do with this project is introduce either an ideal time or distance that would make it more optimal for a returner to go cross field. This could be done by detecting dense field control down field, or lack of. Similar to knowing what formation offense is in, or what coverage defense is in, there is also opportunity is knowing what play the return team has called and knowing what the blocking assignments are. This could help the model understand what is supposed to happen downfield versus what is happening in the play.