Trevor Lammers

12/8/23

NFL Pre Snap Motion - Wrangling Project

1. **Introduction**

A growing scheme that many NFL playcallers are utilizing is the concept of pre snap motion. Identifying coverage types, adding an extra run blocker, and momentarily freezing up a defense are all goals for coaches when using this strategy. The question is, how well does pre snap motion actually work in terms of efficiency and effectiveness? This past semester I have been conducting research to find the change in yards per play, redzone success, the difference in separation, and others trends when comparing motion plays to non motion plays in the NFL. The data and trends found will be used to answer the following three questions:

1. Does motion impact the effectiveness of yards gained each play? What teams utilize the most motion in the NFL?

2. Does pre-snap motion have more success in situations like 3rd down conversions and red zone opportunities? Does motion usage rate change depending on the situation?

3. Is there a correlation between teams that utilize motion the most and the most successful offenses in the NFL?

The report includes the data used, the procedure of my analysis, and the conclusions drawn from the research questions.

2. **Data**

After deciding on this topic, I quickly learned that there was no publicly accessible data regarding pre snap motion for NFL teams. I took the data collection into my own hands, and

have watched and recorded 800 downs of football from Week 16 of last season to use as the sample for my dataset. Each play I recorded the down, distance, play type, yards gained, play direction, and of course, if there was pre snap motion. In addition to that, I recorded binary variables of if the team was in the red zone, if the play resulted in a score, and if there was a pre-snap penalty on the play. Of those 800 plays, 44.38% of them contained pre snap motion.

The second data source I used for this was scraped from Covers.com. This source provided general team statistics from the 2022-2023 season. Columns scraped include Team, yards per game, rush yards per game, pass yards per game, QBR, third down conversion, and points per game. This data will work well with the motion dataset when looking for correlations between motion plays and overall team success. Once loaded into R, it was important to rewrite the team names to match the team names in the motion file, to serve as an identifier if the two files needed to be merged throughout the project. Data dictionaries for both data frames can be found in the appendix at the bottom of the report.

3. Analysis

3.1 Motion on per play basis

The entire project revolved around the following finding: comparing efficiency by looking at the yards per play between motion and non-motion plays. Motion plays averaged 5.97 yards, and non motion averaged 5.30 yards. For comparison, 5.9 yards from motion plays would have finished 6th among all teams in the 2022 season in terms of yards per play, and 5.30 ranked between 16 and 17th in the league (TeamRankings). Figure 1 breaks down the effectiveness by play type, with motion run yards per play being 5.17 and non motion at 4.52. Passing motion yards per play was 7.53, and the non motion yards per play was 7.02.
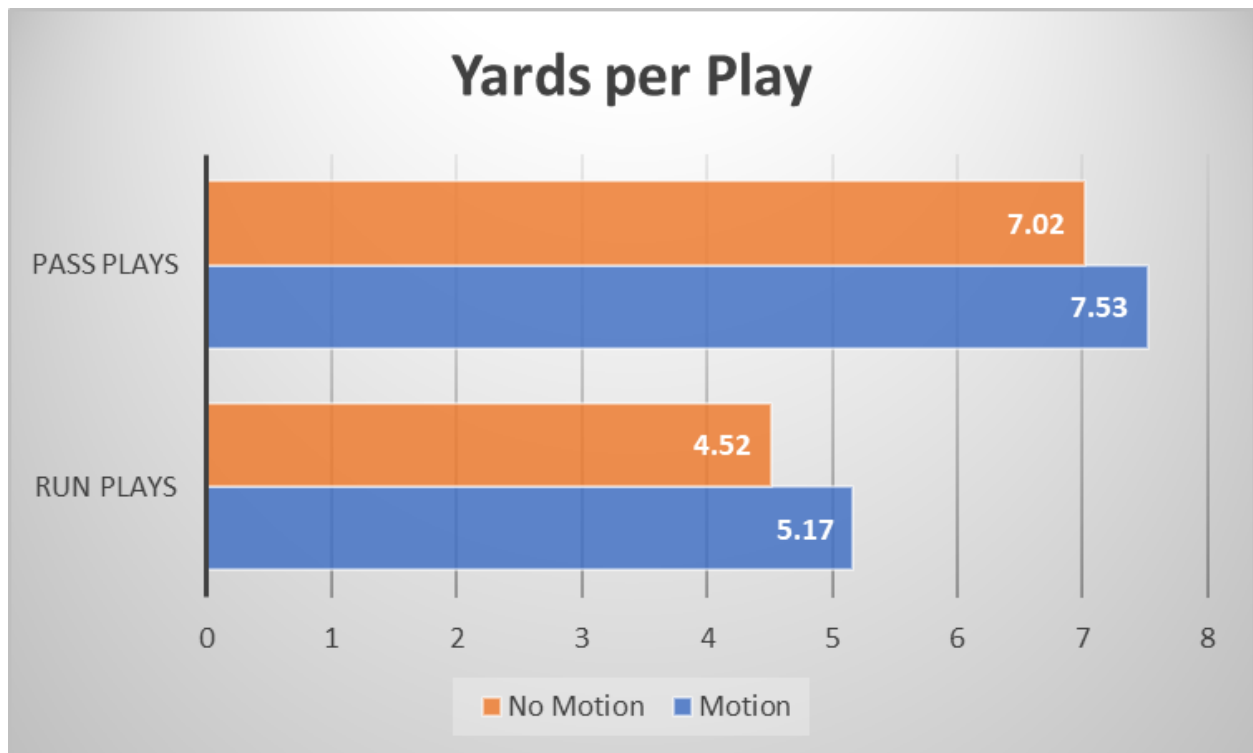
Yards per Play

	No Motion	Motion
PASS PLAYS	7.02	7.53
RUN PLAYS	4.52	5.17

I looked at how well individual teams utilized motion in their offense. In my sample, teams like the 49ers and the Dolphins ranked in the top 10 in both motion playcall percent and yards per play for motion plays. Teams like the Rams and the Falcons called motion plays at a very high rate, but their yards per play was low. The Bills called a low percentage of motion plays but had a high yards per play with those select plays. A full breakdown can be found in the team_stats_df in the R code. It is important to note that even though I recorded 800 plays for this dataset, it boiled down to 25 plays per team, so further analysis for teams like Philadelphia may be needed to draw conclusions about their motion success.
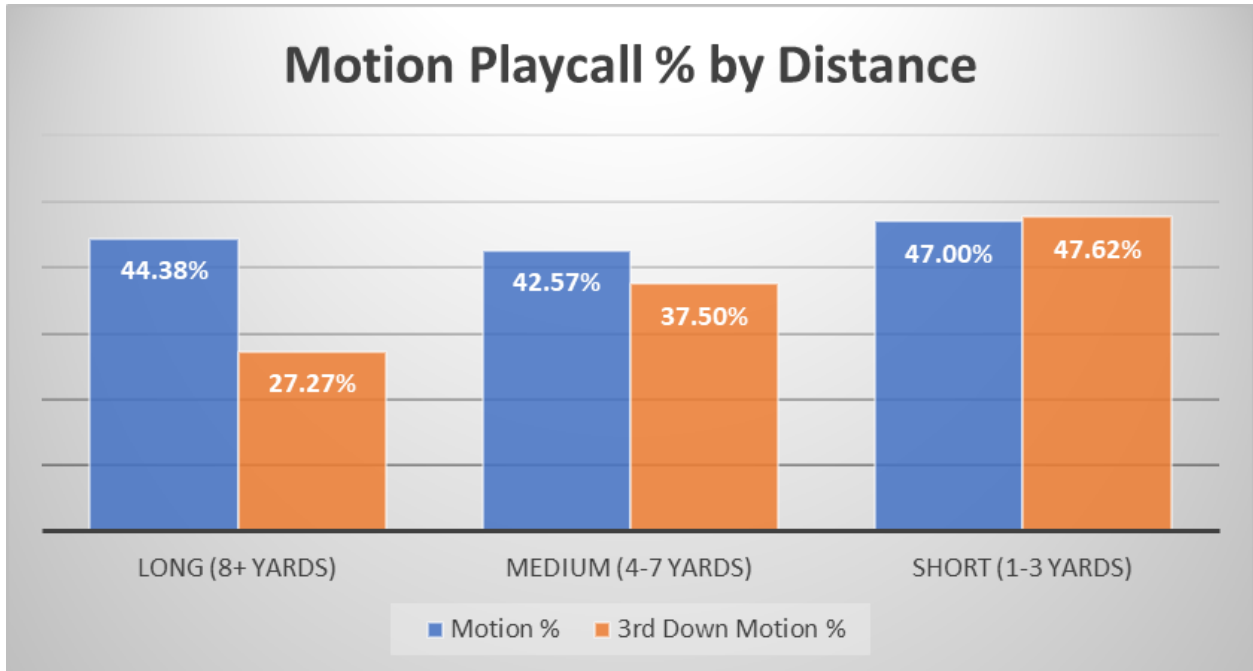
Another way to look at the efficiency of motion is to compare receiver separation between motion and non motion plays. A goal of motion is for the quarterback to identify the defensive coverage, and in the case of motion during the snap, to momentarily freeze the defense. Does it actually help receivers get open? My code found that on average receivers had

2.81 yards of separation on completed motion plays, and 2.65 on non motion plays. This is my most subjective finding, since I recorded the separation for each completed pass strictly on the eye test.

3.2 Motion playcall by situation

Motion can be dependent on the situation of the offense. I looked at playcall trends regarding the down and distance for the offense, and found the percentage of motion playcalls. 1st, 2nd, and 4th down plays all hovered around 45%. Surprisingly, 3rd down motion dropped off to just 35%. Some of this can be attributed to the distance to the first down as well. In my code, I grouped distances of 1-3 as "short", 4-7 yards away as "medium", and 8+ yards from the first down as "long". A short down and distance resulted in the highest motion playcalling, at 47%.

Breaking it down further, I wanted to find the effectiveness on 3rd down. To start, I used my findings from above and looked at just the 3rd down playcall percentage. There was more than a 20% difference between motion play calling on 3rd and long and 3rd and short. This can explain why the 3rd down motion percent was so much lower than the other downs. Teams do not feel the need to use motion if they have more than 8 yards to go and need a first down, again showing why the concept is situational. Since 3rd and long was primarily non motion and the odds of picking it up were low, I excluded those plays when calculating 3rd down conversions. I looked at everything under 8 yards, or what is known as "3rd and manageable". Motion plays in that category had an exact 50% 3rd down conversion rate, and non motion plays had a 42.31% conversion rate. There was an 8% difference in effectiveness on picking up 3rd and manageable.

Motion Playcall % by Distance

	LONG (8+ YARDS)	MEDIUM (4-7 YARDS)	SHORT (1-3 YARDS)
Motion %	44.38%	42.57%	47.00%
3rd Down Motion %	27.27%	37.50%	47.62%

Another factor of effectiveness is the ability to find the endzone. My data showed that 58.33% of scoring plays had pre snap motion, which is impressive considering that only 44.38% of total plays recorded had motion. It may not be surprising though after learning that motion usage rate went up in the red zone. Inside the 20, the yards per play for plays with pre snap motion was 3.90, and the no motion yards per play was 3.26. Motion plays gained 19.5% more yards on average than non motion plays in the red zone.

Redzone Yards per Play

NON-MOTION PLAYS	3.26
MOTION PLAYS	3.9

0   0.5   1   1.5   2   2.5   3   3.5   4   4.5
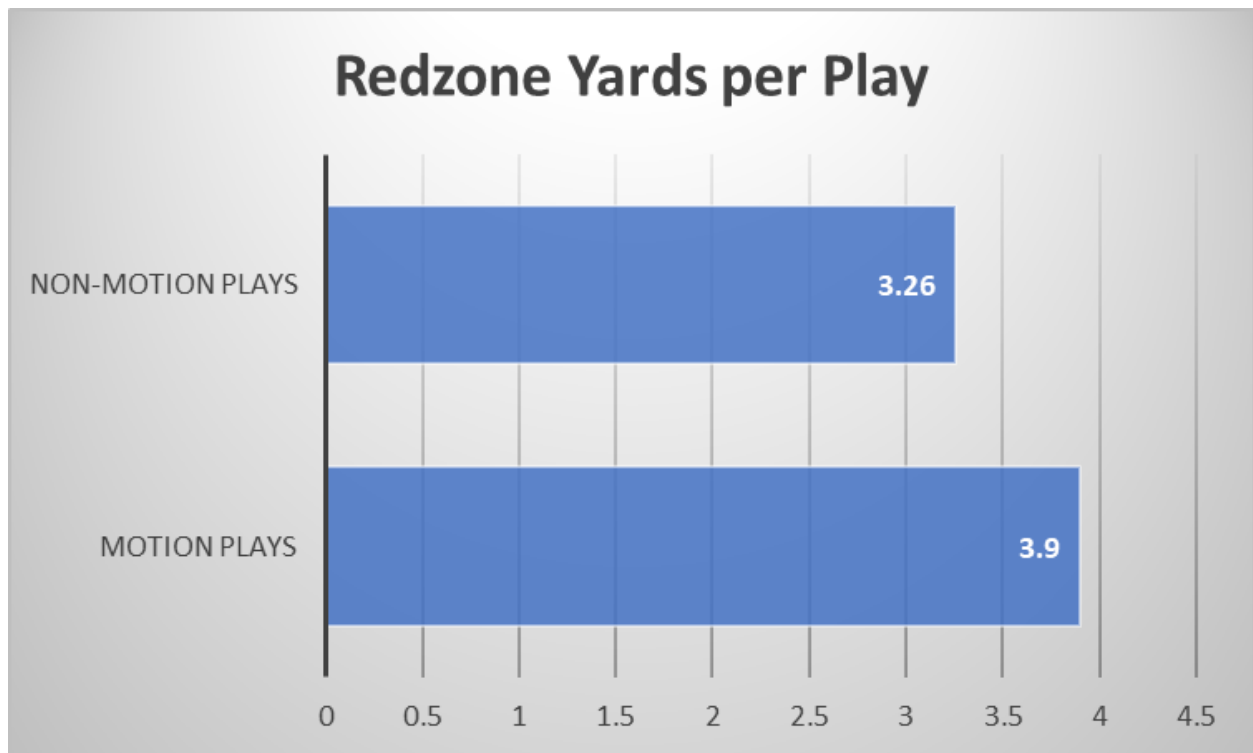
While my report shows that pre snap motion can make offenses more effective and efficient, it is clear why NFL teams use it as a situational concept. Motion plays were not as effective on long down and distances, particularly on 3rd down. In addition, I also recorded pre snap penalties on the 800 plays I used in my sample. This included things like delay of game, illegal shift, false start, and illegal formation. 70% of those penalties occurred on motion plays.

3.3 Correlation to team success

Something else to consider was whether or not there was a correlation between teams that use motion the most and overall team success. To work through this problem, I utilized the motion and the team statistic dataset scraped from Covers.com. The goal was to create a list of teams that appeared in the top ten in both motion play call percentage as well as offensive yardage. I sorted the two datasets by motion play percentage and yards per game, respectively, and sliced the dataset to keep just the top ten. After that I merged the teams that appeared in both by inner joining the two new datasets, matching by team. Here were the results:

	Team	motion_ypp	Nomotion_ypp	motion_playcall_pct	Yards_Game
1	Dolphins	12.812500	6.555556	64	364.5
2	Lions	5.071429	6.363636	56	380.0
3	49ers	9.153846	5.416667	52	365.6
4	Chargers	5.384615	5.083333	52	359.3

As shown in the picture, the Dolphins, Lions, 49ers, and Chargers were the teams that appeared in the top ten in both motion play percentage and offensive yards per game. Matching just four of the ten teams from the data is not enough evidence to determine that there is a strong correlation between motion playcalls and offensive success.

4. Conclusion

This project analyzed multiple aspects of how pre-snap motion impacts the game of football. I looked at motion on a per pay basis, how it varies depending on the situation, and if it relates to overall team success. My research led to the following results:

1. *Does motion impact the effectiveness of yards gained each play? What teams utilize the most motion in the NFL?*

   On average, motion plays picked up more yards each play than non motion plays did. Motion was more successful regardless of a run or a pass, and remained true for a majority of individual teams. Looking specifically at pass plays, receivers also seemed to gain slightly more separation when pre snap motion was called.

2. *Does pre-snap motion have more success in situations like 3rd down conversions and red zone opportunities? Does motion usage rate change depending on the situation?*

   It was clear that motion usage was dependent on the situation. In third down and long situations, teams opted to not use motion. When it came to picking up a third and

manageable, motion plays were more effective, with a 50% conversion rate compared to a 42% conversion rate on nonmotion plays. Motion plays gained 19.5% more yards on average than non motion plays in the red zone, and more than half of the scoring plays recorded used motion.

3. *Is there a correlation between teams that utilize motion the most and the most successful offenses in the NFL?*

Only four teams appeared in the top ten in both motion play call percentage and offensive yards per game. Based on that, there is not a strong correlation between high motion usage and offensive success.

In conclusion, I found that motion plays are beneficial to the offense, and can help make possessions more effective. While there are some drawbacks, there is lots of evidence to show why teams should incorporate more pre snap motion. However, it is clear that it is a situational concept, with there being very little correlation between high motion usage teams and overall offensive success. Regardless, being able to effectively use motion in the right situation can greatly benefit the offense.

Appendix

Data Dictionary 1 - Motion data

Field	Type	Description
Date	Text	Week game was played
Offense	Text	Team on offense
Defense	Text	Team on defense
PlayNo	Numeric	Number of plays offense has run
Down	Categorical	Current down for play (1-4)
Distance	Numeric	Yards to gain for 1st down
Motion	Binary	If there was pre snap motion
Play Type	Categorical	What play was ran (run, pass, sack)
Gain	Numeric	Yards gained on the play
Side	Categorical	Side of field the play was run
Redzone	Binary	If the play was run in the red zone
Separation	Numeric	Yards of separation on completed pass
Score	Binary	If the play resulted in a touchdown
Penalty	Binary	If there was a pre snap penalty

Data Dictionary 2 - 2022 Team Game Statistics

Field	Type	Description
Team	Text	NFL Team ID
Yards_Game	Numeric	Offensive yards per game
Rush_Game	Numeric	Team rushing yards per game
Rush_Play	Numeric	Average rushing yards per play

Pass/G	Numeric	Team passing yards per game
QBR	Numeric	Quarterback rating
Sacks	Numeric	Total sacks taken
third_pct	Numeric	Team third down conversion %
Poss/G	Time	Average minutes of possession per game
Points_Game	Numeric	Team points per game

Works Cited

"NFL Football Stats - NFL Team Yards per Play | TeamRankings.com."

Www.teamrankings.com,

www.teamrankings.com/nfl/stat/yards-per-play?date=2023-02-13. Accessed 8

Dec. 2023.

"NFL Team Offense Stats 2022-2023 - Points per Game, QBR & More." *Covers.com*,

www.covers.com/sport/football/nfl/statistics/team-offense/2022-2023.

Game film used to record motion motion data provided by www.nflvideo.com