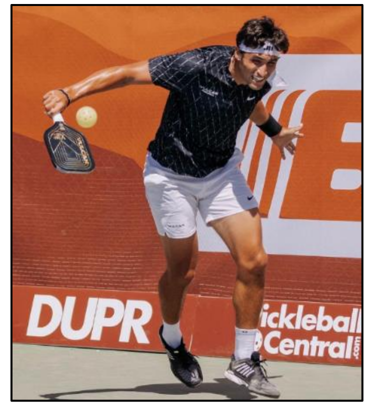
What does the ideal return look like?

Overview

The return is a unique shot that gets hit in virtually every rally! What makes it special? It's the only shot in a rally where a player can place the ball in any part of the court while knowing that their opponents must let the ball bounce.



Pro player Jay Devilliers hitting a return

Missing your return is considered a cardinal sin, and rightfully so. You're letting your opponents win the rally without making them hit the most difficult shot in pickleball, the third!

This study attempts to determine which factors, if any, make a return more effective in competitive doubles. Specifically, the following factors are considered:

- Depth
- Direction
- Pace

We tentatively conclude that more depth on the return is generally preferable (shocker), and that returns hit down the line are generally more advantageous, especially when returning on the right side. Any impact of the pace of a return on rally outcomes is difficult to identify at this point.

Assumptions

While avoiding errors on the return is goal number one, most high-level doubles players are able to make their returns with remarkable consistency.

Skill Level	Total Returns Attempted	Error Rate
4.5-5.0	1,236	5.18%
Pro	1,778	3.04%

Other analyses of gold medal matches, such as those on the Pro Pickleball Stats Facebook Group on the PPA tour often showcase return sub 3% error rates.

With this in mind, we will assume that high level players should be able to consistently get their returns in play. We also assume that they have some control over their ability to place their return (depth and direction), and the pace that is applied.

Conventional Wisdom

For many players, the primary goal of the return is to hit the ball in play. The second priority is to hit the ball deep, but with enough margin for error that consistency is not compromised. The direction of the return is often neglected, except when targeting a weaker player[1]. With regards to pace, many argue that hitting a higher "floaty" return is more effective since it creates time for the returner to get to the non-volley zone.

Data Used

This study used return information, third short performance, and rally outcomes from ~3,000 rallies spanning 4.5, 5.0, and Open/Pro level matches stored in the pklmart. While the majority of matches feature 4 right-handed players, a small number feature left-handed players. Additionally, most matches are gendered doubles (both women's doubles and men's doubles), with a small number of mixed doubles matches. While skill level, hand dominance, and gender add

1 Many high level players elect to return down the line when stacking in order to reduce the amount of court the returning player must cover on the fourth.

nuance to a return and subsequent third shot, they are not explicitly broken down in this analysis. We hope to further explore the impact of these features as additional data becomes available[2].

The location of each return is based on where contact was made on the subsequent shot, not where the ball actually landed. Because of this we are not able to identify cases where thirds are either taken on the rise, or at the "end" of their path.

Analysis

The depth, location, and pace of returns are first analyzed independently. Finally, a basic check for collinearity is performed. For each feature, a set of metrics that reflect rally outcomes and subsequent third shot tendencies are calculated. For each of these outcomes/third shot metrics calculated across *all* returns, please see the appendix.

Depth

In order to understand how return depth factors into rally outcomes, returns are grouped into the following 5 buckets based on where the subsequent third shot was hit, as shown in Figure 1.

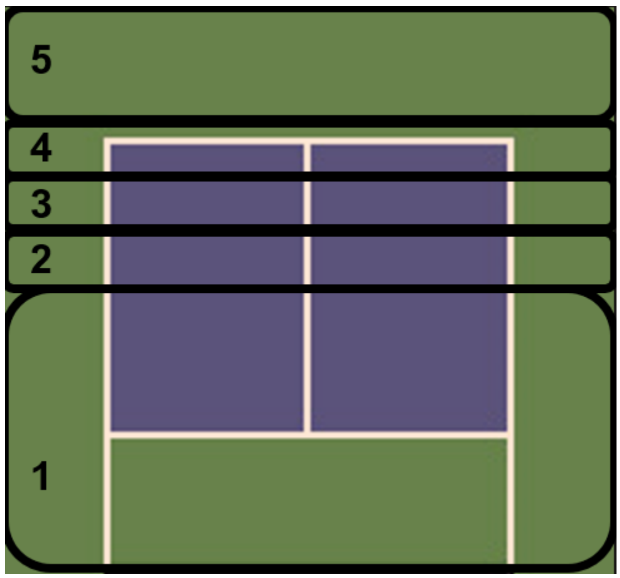


Figure 1. Bucketing of return depth is based on where the subsequent third shot was hit

For each zone, the percent of rallies won, along with metrics related to the subsequent third shot are shown in Table 1.

Depth Zone	Returns Attempted	Win %	Third Shot Drive %	Third Shot Drop %	Third Shot Error %
1 (Short)	154	55.2%	48.1%	52.0%	11.0%
2	234	54.7%	51.3%	48.7%	12.4%
3	391	60.9%	38.7%	60.0%	10.2%
4	988	60.7%	41.5%	58.0%	12.3%
5 (Deep)	420	57.9%	35.8%	62.4%	11.4%

Table 1. Rally and third shot outcomes by return depth

A general trend is that depth is preferable, with some caveats. Hitting into Zone 1, which includes what most would consider too short of a return, did not differ significantly from those in Zone 2. This could be attributed to two factors:

1. Many players are not used to/comfortable with hitting thirds in Zone 1
2. Zone 1 includes a decent number of let cord winners 😊

2 Interested in helping collect data (or using it for your own analyses?) – reach out! pklmart.analytics@gmail.com

Forcing your opponent to hit a third shot from Zones 3, 4, or 5 results in a higher win percentage than letting them take the shot from Zone 2. A one-sided test of significance between these proportions (.601/ N=1799 vs. .547/N=234) yields a p-value of .057. In other words, we should feel *fairly* confident that hitting into these deeper zones is advantageous.

But what about the decrease in win percentage in Zone 5 compared to that of Zones 3 and 4? While we have no conclusive answer, we do know that players hitting their third shot in Zone 5 are dropping more often than in any other Zone. Common advice for hitting an effective third shot drop is to make contact with the ball at a low point, around the knees. Perhaps players hitting third shots in Zone 5 are letting balls drop to a height where they can hit a more effective drop.

Location

As in the depth analysis, the court has been grouped into three location zones. These are the zones that, in conjunction with the side the return is hit, define if a return was hit cross court, in the middle, or down the line as shown in Figure 2.

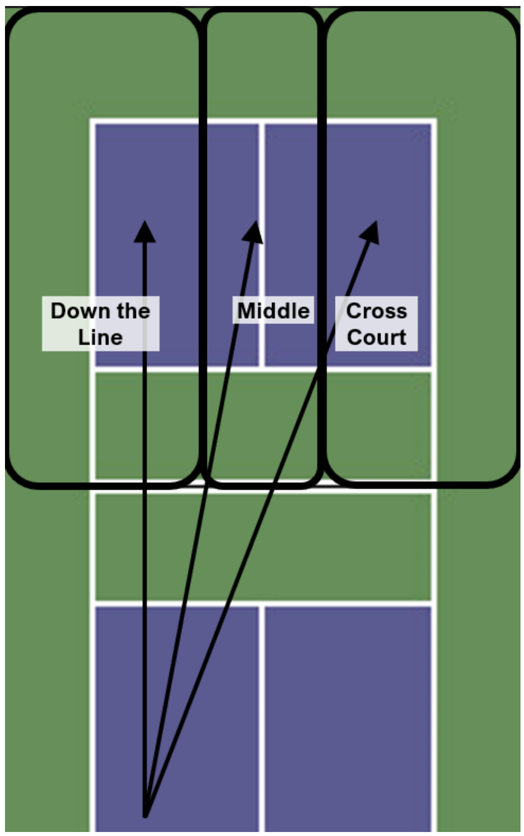


Figure 2. Example of how shots hit from the left side would be grouped into one of three locations

For each combination of return side and location, the percentage of rallies won, along with metrics related to the subsequent third shot are shown in Table 2.

Return Side	Location	Returns Hit	Win %	Third Shot Drive %	Third Shot Drop %	Third Shot Error %
Right	Cross Court	477	55.4%	45.0%	53.1%	10.8%
Right	Down the Line	402	60.0%	36.0%	63.5%	10.5%
Right	Middle	407	56.0%	41.9%	59.6%	12.5%
Left	Cross Court	348	57.5%	40.1%	60.2%	12.9%
Left	Down the Line	292	58.2%	45.3%	50.9%	12.5%
Left	Middle	338	57.1%	47.9%	52.1%	11.3%

Table 2. Rally and third shot outcomes by return location

Let's start by looking at returns from the right side. Notable, returning to the middle results in a slightly higher error rate on the third shot. However, the greatest win percentage comes from returns hit down the line. With the knowledge that the opponent's left side player is most often right-handed[3], going down the line is more likely to result in a backhand being hit on the third shot. Many players do not utilize a backhand drive in doubles, supported by the high rate of third shot drops (60.2%) in this category. Running a one-sided test of significance between the percentage of rallies won when going cross court or middle versus going down the line (.557/ N=884 vs. .600/N=402) yields a p-value of .069, indicating that we should be *fairly* confident that something is going on here.

Another potential explanation as to why going down the line is effective, especially when returning on the right side, has to do with confusion on covering the middle when handling the subsequent third shot. When the returning team goes down the line, handling the third shot is usually straightforward: the player who hit the return covers line and the player already at the net covers everything else. This concept is visualized in Figures 3 & 4.

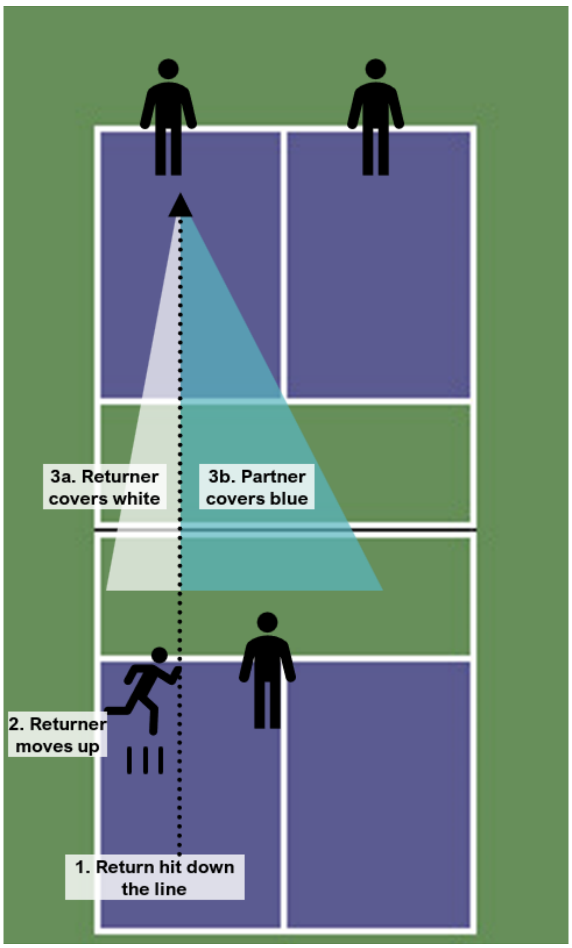


Figure 3. Returning team coverage when return hit down the line

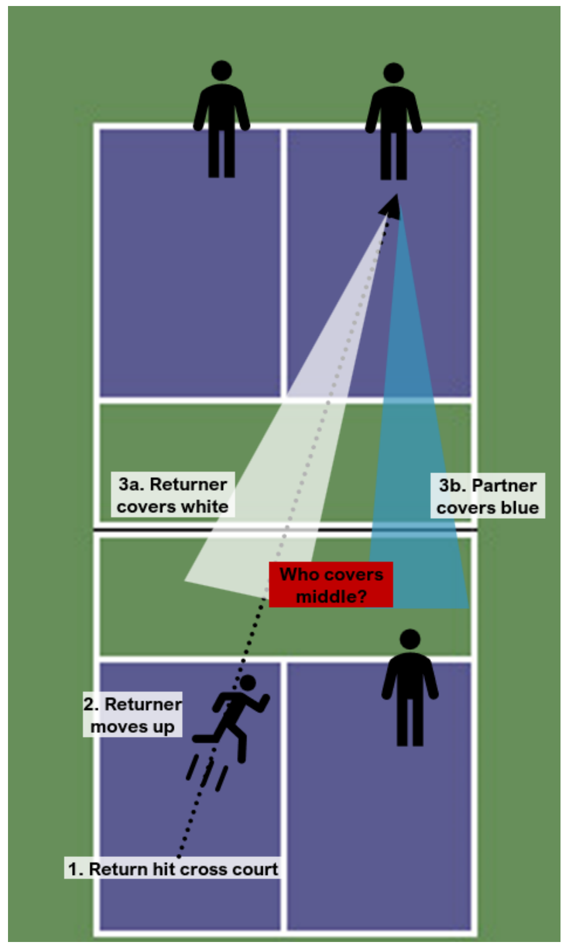


Figure 4. Returning team coverage when return hit cross court

Pace

If you're reading this, then congratulations, you've probably *paced* yourself… ha. But really, let's talk about pace. It's a weird one. On one hand more pace is generally harder to handle. But on the flip side it gives the returner less time to get established at the kitchen. Given the way the data is collected, it is probably the least precise of three features we have

3 Assuming that right-lefty teams will always stack their forehands in the middle on serve, the only case where the opposing left side player is lefty is when both opponents are left-handed.

analyzed. In short, because data entry users are clicking whenever a ball is struck, the relative time between clicks,[4] combined with the distance traveled allows us to estimate pace.

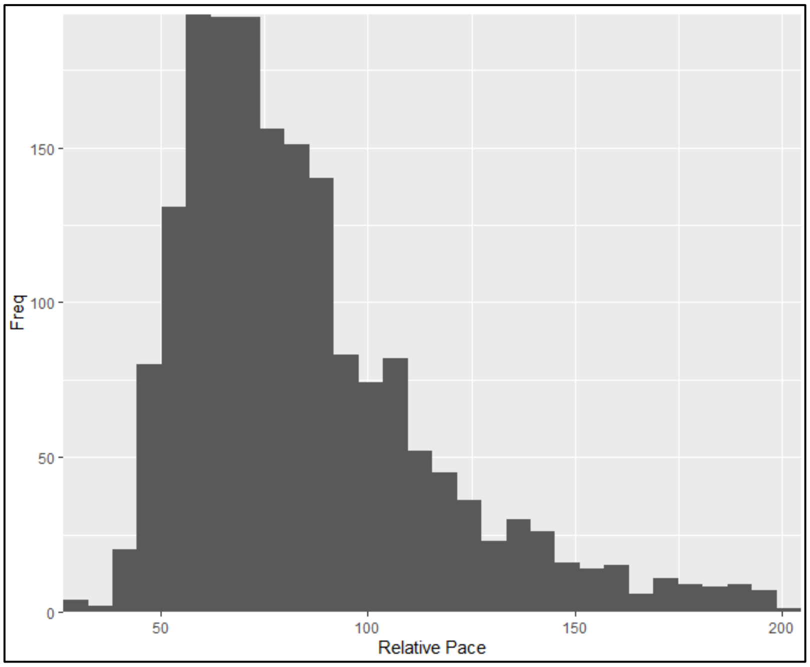


Figure 5. Distribution of estimated pace (unit of measure is only relative to other observations)

Looking at Figure 5., pace follows a right-skewed normal distribution. Intuitively this makes sense as most players push or slice their returns. But occasionally you get a player who will whale away. In an attempt to compare shots of different speeds, three buckets are used. Along with each bucket, the percent of rallies won, along with metrics related to the subsequent third shot are shown in Table 3.

Pace Bucket	**Returns Attempted**	**Win %**	**Third Shot Drive %**	**Third Shot Drop %**	**Third Shot Error %**
1 (Slow: 0-80)	964	58.2%	38.6%	60.3%	11.3%
2 (Medium: 81-120)	586	61.3%	42.9%	57.1%	12.6%
3 (Fast: 121)	639	58.7%	44.9%	54.2%	11.3%

Table 3. Rally and third shot outcomes by pace bucket

It is difficult to infer much from these summary statistics. One could speculate that medium paced returns give the returner enough time to get set at the kitchen, but not enough time for the opponent to hit a quality third shot. While the win rates vary, they are not quite statistically significant. For example, running a statistical test (again, a one-sided comparison of proportions) comparing the win percentage of 61.3% for medium paced returns to the 58.7% for fast paced returns results in a p-value of .176. So… maybe there's something here? It's just too hard to tell at the moment.

Another potential takeaway is that the return allows the returning team to set the pace of the rally as we see that "Fast" returns yield the highest percentage of third shot drives, while "Slow" returns yield the highest percentage of third shot drops. Additional driving of third shots on fast returns could be due to the fact that the returning player is less likely to be set at the kitchen when the third is struck, thus making a third shot drive more effective. Additionally, any impact that the pace of the serve impacts the pace of the return was not analyzed (perhaps the servicing team is setting the pace!)

4 Time between clicks is normalized for each game collected, such that users can rewatch videos at any speed they like.

A Basic Check for Collinearity

We have seen that:

- Additional depth is generally preferable
- Returning down the line has advantages, especially when returning on the right side

However, let us do our due diligence and check if these two factors are correlated. For example, are returns hit down the line generally deeper than other returns? If so, it may be difficult to understand if depth or location (or both) is the driving factor behind an effective return. As a basic check, the average and median depth for each of the directional buckets is shown in Table 4.

Return Side	Location	Returns Hit	Avg Depth of Third Shot Contact (ft)
Right	Cross Court	477	19.9
Right	Down the Line	402	19.9
Right	Middle	407	19.6
Left	Cross Court	348	19.8
Left	Down the Line	292	20.5
Left	Middle	338	20.0

Table 4. Average depth of returns (as measured by where the third shot was hit) by return location

We do not see any significant differences in the average depth across the return location, which leads us to believe that our aforementioned conclusions are valid.

Appendix

Returns Attempted	Win %	Third Shot Drive %	Third Shot Drop %	Third Shot Error %
2,264	57.3%	42.6%	56.7%	11.7%

Rally outcomes in aggregate, no breakout by any return feature. Note that a small number of third shot lobs explain why the drop and drive percentages do not add up to 100%. Win rate should not be used to estimate the advantage of returning. In reality, the data is skewed with more rallies where the lower skilled team is returning. This is a function of how scoring works in pickleball (the winning team will always serve more rallies, at least within a game).

Acknowledgements

A big shoutout goes to all my friends who I have met both playing pickleball in the D.C. area, and all of those I have met online at the pklmart through a shared interest in competitive pickleball data. Many of these folks proofread and provided additional insights on this analysis, while others have and continue to assist in the data collection process.

If you or anyone you know is interested in assisting in collecting pickleball data (which could include analyzing your own match!) please let us know and we'll get you setup.

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