投稿類別：物理類

篇名：How do swing paths influence horizontal displacement in hitting a baseball?

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I. Introduction

(I) Problem

Many kids in the world are actively engaged in team sports to build cognitive abilities, physical abilities, mental strength, cooperation skills, and, most importantly, having fun and building friendships. Baseball is a sport that is played around the world, but especially in the North America/Caribbean region and in East Asia. As these kids who start playing baseball at a young age gradually grow, their abilities would also need to grow and develop with them as the sport becomes more and more competitive.

Swinging is a key component in playing baseball as everyone hits at levels below highschool. In a competitive atmosphere, everyone pushes to be better, but one can be smarter about it. How a swing comes together can play a big role in a batter's production. A batter's production is connected to the horizontal displacement of the ball as the further the ball goes, the closer you are to advance a base. In baseball's highest stage, Major League Baseball, hitter's swing can generally be split into two categories. First, there is a swing where the tip of the bat goes below the end of the bat in the horizontal plane before reaching the area above home plate by tilting the body. I will call this an uppercut swing. Secondly, there is a swing where the tip of the bat only goes below the end of the bat in the horizontal plane at the area above home plate. I will call this a slap swing.

Accessing a swing has a number of points to consider. How does the initial velocity vary? How does the launch angle vary? How does the point of contact vary? How does the quality of contact vary? I will be looking at this problem from a result based point of view. Physical trainers can have various different opinions about this and how human autonomy works together to maximize productivity, but results are fixed and can be analyzed.

(II) Purpose

A. To find out which swing is more efficient

B. To explain why each swing will lead to a different outcome

C. To explain how each swing can improve productivity

(III) Research Question

Which swing between the uppercut swing or slap swing results in a greater horizontal displacement?

II. Literature Review

In the Literature Review, all information relevant to the slap swing and the uppercut swing is going to be researched. This information will be connected to the Analysis and Results section for a complete overview of the topic.

(I) Key Components

A. Initial Velocity

(A) The initial velocity off the bat can correlate with the amount of power transferred from the bat to the ball as the kinetic energy is formulated through the force of the ball and the force of the bat. This is in relation to horizontal displacement as the time for the ball to drop from maximum vertical displacement is the same in all cases. Due to this, the faster the ball is, the greater horizontal displacement as the ball would be able to accumulate a greater displacement in the fixed period of time (*Forces Between Bat and Ball*).

B. Launch Angle

(A) Launch Angle is the angle the ball travels in relation to the horizontal plane at the point of contact, which is 0 degrees. Launch angle is related to horizontal displacement as it determines how efficient is the initial velocity used. The greater the launch angle, the more time will be available for the ball to travel horizontally. 28 degrees is widely accepted by baseball scholars as the perfect launch angle due to ability for the horizontal velocity of the ball to be at 88.29 kilometers per hour (kph) as it is adjacent to the hypotenuse, which has a velocity of 100 kph as a base (Stump et al., 2020). For the same initial velocity, the launch angle of 28 gives a vertical velocity of 46.95 kph as it is the opposite of the 28 degree angle (Sackman & Antonio, 2023). This makes time equal to 4.79 seconds to reach the maximum vertical displacement as known through $t = \frac{v-u}{a}$, where t is time, v is final velocity of 0, u is initial velocity of 46.95 and a is acceleration or gravitational pull, which is -9.81. Time will be the same both to the equilibrium and away from the equilibrium theoretically so the total time to travel will be 9.58 seconds. This is the best case scenario when considering both horizontal velocity and time (Sackman & Antonio, 2023) (Stump et al., 2020).

C. Position of contact of the center of the ball on the bat

(A) Position of contact is important for both launch angle and initial velocity. Point of contact for initial velocity decides the amount of force transferred to the ball. The round shape of the bat condenses energy at the center of the bat, relative to the swing path (*Forces Between Bat and Ball*, n.d.). Hitting the center of the ball with the center of the bat will theoretically give the ball greater initial velocity, allowing it to increase its horizontal displacement in a shorter period of time. The point of contact also places a significant role in launch angle as the angle the position the ball and bat impacts can affect the result of the contact. Hitting the bottom of the ball will theoretically result in a fly ball, while hitting the top of the ball will theoretically result in a ground ball (*Baseball Science 101: The Physics of Hitting a Home Run*, 2017) (Stump et al., 2020) (Cross & Lindsey, 2013). Fly balls have positive launch angles so fly balls will result in greater horizontal displacement than ground balls.

(II) Data Collected

Through pages providing baseball statistics, such as Fangraphs, Baseball Savant, and Baseball Reference, I was able to compare the outcome of players with uppercut swings and players with slap swings.

A. In Figure 1, comparisons of eight players, creating four different sets of players who are paired through similarities in oWAR, Offensive Wins Above Replacement, metric for interpretation of offensive production, 0 is replacement level, used in this data set to find similar contributors' factors that may impact horizontal displacement. Molded into a sample size of 500 opportunities. The players are each paired with another player of relative oWAR but with a different type of swing. The table includes average exit velocity, which is Average Exit Velocity after impact with the bat; the launch angle, which is the angle the ball goes after impact with bat; the sweet spot percentage, which is how often the ball comes in contact with the center of mass of the bat, measures the amount of control the play has with different swings; average home run displacement, which is an average displacement of the balls with greatest displacement; maximum distance, which is the greatest displacement; Topped% / Under%, which measures bat control, the point the center of the bat contacts with the ball; and Ground Ball% (Down), Fly Ball % (~45 degree angle), Line Drive % (Straight Forward), Pop Up % (Up), which explains how the path of the bat influences the result of the contact. Sorted each player's swing type through videos in MLB Film Room (Albert, 1994).

(A) Data Collected

	Uppercut Swing	Slap Swing	Uppercut Swing	Slap Swing	Uppercut Swing	Slap Swing	Uppercut Swing	Slap Swing	Optimal
oWAR/500PA	5.240174672	5.008347245	3.776978417	3.808752026	3.388278388	3.617945007	2.098408104	2.351097179	
Player	**Judge**	**Ohtani**	**Bellinger**	**Arraez**	**Harper**	**Ramirez**	**Happ**	**Swanson**	
avg Exit Velo	156.16	151.04	140.64	141.28	146.88	144	143.84	142.88	Higher the better
avg Launch Angl	20.4	13.2	17.2	11.5	9.1	18	13	13	15~20
Sweet Spot %	37.1	35.6	38	44.7	36.8	36.8	36.5	35.1	Higher the better
avg HR Distance	124.3584	128.6256	120.7008	115.5192	124.6632	122.5296	122.5296	119.7864	Further the better
Max Distance	141.4272	150.2664	133.5024	124.968	137.4648	131.3688	130.7592	130.7592	Further the better
Topped %	17.9	31.5	25.5	31.2	32.7	26.5	30	32.9	lower the better
Under %	20.8	19	34	26.2	17.8	31.3	23.7	22.8	lower the better
Ground Ball %	30.4	42.6	35.8	42.8	45.3	34.9	41.8	44.1	lower the better
Fly Ball %	40.8	30.3	29.2	24.1	22.8	28.5	25.6	25.2	higher the better
Line Drive %	22.5	22.7	26.4	30.7	27.2	26.3	25.6	24.2	higher the better
Pop Up %	6.3	4.5	8.5	2.4	4.7	10.3	6.9	6.5	lower the better

Figure 1 (Created by Researcher) The data collected from eight different players.

B. In Figure 2 and Figure 3, I have made a mass sample of players with slap swing and uppercut swings to find the average of the players with 400+ plate appearances' average exit velocity, average launch angle, sweet spot %, topped %, under %, ground ball %, fly ball %, line drive %, pop up %.

(A) Uppercut Swing

Uppercut	avg Exit Velo	avg Launch Angl	Sweet Spot %	Under %	Topped %	Ground Ball %	Fly Ball %	Line Drive %	Pop Up %
Adames, Willy	87.4	18.2	35	30.2	23.9	36.3	31.5	22.3	9.9
Alvarez, Yordan	93.3	17.1	35.7	27.3	23.3	36	35.7	22.4	5.9
Bell, Josh	90.1	9.3	31.3	22.6	36.3	48.8	26	21.4	3.8
Bellinger, Cody	87.9	17.2	38	34	25.5	35.8	29.2	26.4	8.5
Belt, Brandon	88.7	19.8	44.5	32.5	15.5	31	39	24	6
Benintendi, Andrew	86.6	14.5	40.9	30.2	28.7	39.6	26.6	28.5	5.2
Betts, Mookie	92.4	20.6	42.5	29.7	20.5	27.6	35.7	29.3	7.5
Blackmon, Charlie	86.4	18.1	39	31.8	28.2	36.4	25.6	27.9	10.1
Bohm, Alec	89.4	11.1	35.1	24.7	33.6	42.6	23.8	28.5	5.1
Báez, Javier	88	9.4	28.9	21.9	39.9	50.5	23.5	21.4	4.6
Call, Alex	86.8	17	30.5	34.8	27.5	39.4	28.8	20.2	11.6
Candelario, Jeimer	88.3	14.1	36.9	27.7	29.6	39.8	28	25.1	7.1
Canha, Mark	87.9	13.1	30.9	28.5	32.6	43.9	25.4	21.8	8.8
Castellanos, Nick	88.9	14.4	36.5	24.2	28.2	41.8	28.9	24.4	4.9
Chapman, Matt	93.4	18.5	32.4	29.2	27.2	35	30.6	23.1	11.3
Correa, Carlos	90.4	10.6	31.1	22.8	30.8	46.4	21.5	24.9	7.3
Crawford, J.P.	88.3	15.1	35.3	26.6	27.3	39.6	23.7	28	8.7
De La Cruz, Bryan	89.9	11.8	41	23.1	30.5	40.7	24.9	29.4	5
DeJong, Paul	85.5	16.8	34.8	29.6	24.1	39.9	28.1	21.7	10.3
Drury, Brandon	89.9	11.8	35	22.3	31.9	42.7	26.3	24.6	6.5
Duran, Ezequiel	90.1	14	36.3	25.3	29.1	39.8	23.2	29.4	7.6
Flores, Wilmer	86.4	22	36.2	34.8	21.4	31.9	29.9	23.5	14.8
France, Ty	87.5	13.7	36.9	25.3	29.3	41.8	23.1	26.5	8.5
Frazier, Adam	85.7	15.2	40.9	32.6	29.4	37.4	25.1	29.7	7.7
Friedl Jr., TJ	86.7	16.1	32	30.6	26.9	42.8	25.9	22	9.3
Gomes, Yan	87.4	15.1	37	30.2	26	37	28.9	25.6	8.4
Gorman, Nolan	91	22.2	38.8	29.6	19.6	28.5	38.5	23.8	9.2
Grandal, Yasmani	87.9	10.8	32.3	28.3	33.3	45.2	25.4	24.7	4.7
Grossman, Robbie	88.2	20.2	32.3	36.5	23.2	32.3	35.4	24	8.4
Happ, Ian	89.9	13	36.7	27.3	30	41.8	25.6	25.6	6.9
Harper, Bryce	91.8	9.1	36.8	17.8	32.7	45.3	22.8	27.2	4.7
Heim, Jonah	89.2	17.3	34.3	31.6	25.5	36.3	29.9	26.1	7.7
Joe, Connor	88.9	16.7	37.2	27	25.7	35.5	25.3	28	11.2
Judge, Aaron	97.6	20.4	37.1	20.8	17.9	30.4	40.8	22.5	6.3
Kelenic, Jarred	90.9	10.1	38.8	16.9	31	43.8	24.4	29.8	2.1
Kepler, Max	91.9	14.7	35.7	27.7	26.8	37.5	31	25.6	6
Lindor, Francisco	91.2	19.2	35.8	33.1	23.9	34.1	31.4	24.2	10.4
Lowe, Brandon	91.4	16	32.6	28.4	27.6	41.4	30.7	20.3	7.7
Lowe, Josh	89.1	14.3	36.2	25.2	29.9	39.1	29.3	25.5	6.1
McKinstry, Zach	87.2	17.8	37.1	31.2	26.1	35.7	34	26.1	4.2
McLain, Matt	89.3	13.8	39.6	23.6	25.2	40	26.4	27.2	6.4
McMahon, Ryan	90.8	9.7	39.4	20.3	28.3	44.2	28.1	26.1	1.7
Melendez Jr., MJ	93.2	16.9	34.6	29.4	24	35.4	34.6	25.3	4.6
Mullins II, Cedric	88.9	21.6	28.1	36.8	24.5	36.8	31.3	19	12.9
Muncy, Max	91.2	21.7	33.7	31.6	23.3	33.4	38.5	18.5	9.6
Murphy, Sean	91.5	13.1	38.1	23.8	30	41.4	27.8	26	4.8
Nimmo, Brandon	91.8	12.2	33.5	25.9	31.3	41.2	26.4	25.5	6.9
Noda, Ryan	91.2	16	38.2	25.2	25.6	39.1	30.3	26.1	4.6
Nootbaar, Lars	89.1	7.2	30.8	19.3	36.9	50.5	23	22.4	4.2
Outman, James	87.9	15.7	38.2	25.5	25.5	39.2	30.4	23.2	7.2
Perdomo, Geraldo	85.7	16.4	35.4	35.7	28.3	41.3	27.1	23.3	8.3
Perez, Salvador	90.1	15.6	38	28.2	23.8	36	30.2	26.3	7.5
Peterson, Jace	85.7	14.4	33.5	30.2	31.7	43.2	29.1	20.5	7.2
Raleigh, Cal	89.5	20.3	36.5	33.4	23	31.7	35.1	22.2	11
Rizzo, Anthony	90	17.8	41.2	30.7	25.6	33.9	30.7	28.5	6.9
Robert Jr., Luis	89.1	16.1	38	25.8	25.3	36.4	30.3	24.7	8.5
Rooker Jr., Brent	91.6	17.6	37.3	28.5	23.1	33.2	36.9	24.7	5.1
Santander, Anthony	90.6	20.2	33	34.1	21.9	35	32.5	19.6	12.9
Schwarber, Kyle	92.4	19	34.3	30.8	27.1	34.6	33.8	20.1	11.5
Seager, Corey	93.3	13	38	21.3	27.6	40.3	29.4	27.1	3.3
Semien, Marcus	88.4	19.1	37.5	36.1	24.1	34	35.4	23.5	7.1
Smith, Dominic	86.3	12.8	37	28.3	31.7	42.7	25.8	26.3	5.3
Soler, Jorge	91.3	17.8	36.5	27.2	26.7	36.2	31.6	24	8.2
Suwinski, Jack	90.5	22.4	34.2	34.2	20.6	28.1	36.3	23.1	12.5
Springer III, George	88.3	12	32.2	23.6	31.8	44.8	25.9	22.4	6.9
Torres, Gleyber	89.7	15.1	37.3	27.4	29	38.9	30.6	24.8	5.6
Tucker, Kyle	90.2	14.8	35.4	27	25.4	38.6	32.7	24.2	4.5
Varsho, Daulton	87.8	20.5	34.3	32.6	23.7	35.9	31.1	21.5	11.6
Vaughn, Andrew	90.6	11.2	30.3	23.9	33.7	44.4	23.7	24.4	7.5
Volpe, Anthony	88.7	14.2	35.5	23.9	31.3	41.1	27.6	24.9	6.4
Wade Jr., LaMonte	88.4	17.4	33.6	28.1	24.3	39.5	28.7	23.7	8.2
Walker, Christian	88	15.8	32.6	29.2	28.9	38.7	32.6	19.4	9.3
Yelich, Christian	91.7	3.5	30.4	11.4	42.1	57.4	17.3	22.4	2.9
Yoshida, Masataka	89	3.9	29.5	17.2	41.9	55	19.4	21.4	4.1
	avg Exit Velo	avg Launch Angl	Sweet Spot %	Under %	Topped %	Ground Ball %	Fly Ball %	Line Drive %	Pop Up %
Average	89.47702703	15.34054054	35.56756757	27.62297297	27.67027027	39.10135135	29.10810811	24.42837838	7.367567568

Figure 2 (Created by Researcher) The data collected from Uppercut Swing Hitters.

(B) Slap Swing

Slap	avg Exit Velo	avg Launch Angl	Sweet Spot %	Under %	Topped %	Ground Ball %	Fly Ball %	Line Drive %	Pop Up %
Abrams, CJ	87.4	13.5	32.6	26.2	31	44.8	25.1	20.6	9.5
Abreu, José	89	10.8	32.5	24.8	35.3	45	21.9	26	7.2
Acuña Jr., Ronald	94.7	7.4	33.6	14.9	34.3	48.8	22.4	26.2	2.7
Alonso, Pete	89.5	18.2	32.3	29.5	28	36.3	35.4	19	9.3
Albies, Ozzie	88.7	16.6	37.4	27.4	28.2	36.8	33.8	23.7	5.6
Alfuve, Jose	86	11.4	29.7	20.7	38.6	49.3	21.7	20.3	8.6
Alvarez, Francisco	90.1	12.5	28.6	24.9	36.6	44	31.9	15.8	8.4
Anderson, Tim	87.8	2	32.4	11.8	47.2	61.4	10.7	26.8	1.1
Andrus, Elvis	87.5	5.5	28.1	20.9	44.4	55.9	19.9	19.9	4.2
Arcia, Orlando	88.2	5.4	30.6	19.8	41.6	53.5	20.8	19.5	6.2
Arenado, Nolan	88.8	16.9	33	29.8	28.9	38.8	25.7	24	11.6
Arozarena, Randy	91.7	11.3	31.8	24.3	32.8	43.3	25.3	23.3	8.3
Arraez, Luis	88.3	11.5	44.7	24.8	30.7	42.8	24.1	31.3	1.8
Berti, Jon	85.4	2.4	29.7	15.8	41.1	54.1	19.9	21.8	4.1
Bichette, Bo	90.2	6.2	38.3	14	32.6	46.4	18.8	30.9	3.9
Bogaerts, Xander	87.6	7.9	28.3	23	38.4	49.8	22.6	21.1	6.5
Bregman, Alex	88.6	17.6	35.8	30.2	27.9	35.4	31.1	25	8.6
Brennan, Will	85.7	9.4	35.8	22.8	35.5	47.2	17.8	28.1	6.9
Burger, Jake	91.9	12.3	33.4	20.7	30.8	42.9	21.9	25.1	10.1
Carpenter, Kerry	90.1	13.1	37.2	21.4	29.3	45.1	27.6	22.7	4.6
Carroll, Corbin	90	11	32.7	22.7	34.2	45.3	24	23.3	7.3
Casas, Triston	91.1	15.7	36.1	28.5	27.2	36.4	31.5	25.6	6.6
Castro, Willi	86.5	15.1	34.5	29.2	27.7	41.7	26.1	23.5	8.7
Conforto, Michael	88.9	11.9	31.9	26	30.6	44.7	27.3	22.4	5.6
Contreras, William	91.3	4.7	27.1	16.8	41.5	55.4	20.4	19.9	4.3
Contreras, Willson	91.3	10.1	34.1	20	33.1	48.1	23.1	21.6	7.2
Cooper, Garrett	89	13.3	40.4	21.6	29.1	42.8	25.3	28.1	3.8
Cronenworth, Jake	87.4	15.2	35.7	29.7	28.3	37.6	29.2	26.2	7.1
Devers, Rafael	93.1	12.4	30	24.1	32.4	42.7	28.4	20.6	8.3
Davis, J.D.	91.1	7.8	33.5	16.5	37.7	53.3	20.4	23.1	3.3
Doyle, Brenton	88.3	11.7	29.9	22.8	34.6	49.6	25.6	20.5	4.3
Dubón, Mauricio	87	9.5	37	24	37.3	45.5	22.5	27.8	4.3
Díaz, Elias	88.1	12.7	31.2	24.7	31.2	46.5	19.9	25.3	8.3
Díaz, Yandy	93.4	5.7	30.5	17.1	36.3	52.2	20.8	23.8	3.2
Edman, Tommy	89.1	7.5	27.9	23.1	38.1	51.7	21.4	20.1	6.7
Estrada, Thairo	85.9	10.8	34.7	24.1	30.8	45.4	22.3	25.5	x
Franco, Wander	89.4	8.9	35	18.8	36.3	47.7	23.9	24.7	3.7
Freeman, Freddie	90	15.2	46.6	21.7	25.7	35.9	29.6	30.9	3.6
García, Maikel	91.8	6.1	36.9	16.1	35.3	48.3	18.3	29.2	4.2
García, Adolis	92.1	15.7	36	25.4	28	37.8	36	20.5	5.7
García, Luis	88.3	4.6	31.9	18.2	42.8	53.4	18.2	25.1	3.3
Giménez, Andrés	84.8	13.1	29.9	27.2	31.6	46.7	22.1	21.9	9.3
Goldschmidt, Paul	91.3	12.8	35.6	22.1	28.7	41.4	26.9	25.7	6
Guerrero Jr., Vladir	92.1	10.5	32.4	22.1	33.6	45.3	21.7	26.1	6.9
Gurriel Jr., Lourdes	89.7	10.6	35.3	23.6	33.6	43.3	24.4	26.7	5.6
Henderson, Gunnar	92	11.4	32.9	20.8	32.9	45.8	26.5	23.3	4.5
Greene, Riley	91.6	6.6	36.8	12.4	35.3	48.9	21.8	28.9	0.4
Grichuk, Randal	89.6	14	35	24.4	29.7	40.9	24.4	26.8	7.9
Grisham, Trent	90.3	18.3	32.8	26.9	24.1	38.1	28.1	23.8	10
Harris II, Michael	90.9	7.6	34.6	18.1	35.5	48	17.4	28.2	6.4
Hayes, Ke'Bryan	92.2	13.2	34.1	24.7	29.5	42	26.2	24.9	6.9
Hays, Austin	89.4	10.4	31	25.5	32.3	44.8	29.7	20.3	5.2
Hernández, Enrique	87.8	17	31	34.8	29.4	37.4	28.1	24.3	10.2
Hernández, Teoscar	91.3	12.3	35.2	22.8	29	42.8	26.8	24.9	5.5
Hoerner, Nico	86.6	10.5	33.2	25.8	38.4	47.2	20.3	25.5	7
India, Jonathan	89.5	15.2	37.2	27.8	28.4	39.5	29.3	24.7	6.5
Jiménez, Eloy	90.9	5.7	26	19.7	41.4	53.2	19.7	20	7.1
Jones, Nolan	90.1	9.8	34.7	21.5	29.3	43.8	29.3	23.1	3.7
Julien, Edouard	89.5	8	38.8	14	38.3	50	22.4	26.6	0.9
Jung, Josh	91.8	15	41.9	25.5	25.5	37.4	29.5	29.5	3.6
Kemp, Tony	86.7	10	31.3	26.7	35.6	48.6	25.2	21	5.2
Kiermaier, Kevin	86.7	5.6	29.4	18.3	42.2	55.7	18.7	21.1	4.5
Kim, Ha-Seong	86.2	13.6	36.1	29.5	30.2	41.3	25.2	24.3	9.2
Kirk, Alejandro	87.6	6.3	31.9	20.4	37.7	50.5	21.9	23.1	4.6
Kwan, Steven	86	10.7	37.7	26.3	38.1	46.7	20	28.8	4.6
Langeliers, Shea	90.6	19.6	30.8	33.1	26.9	36.7	31.2	17.5	14.6
Laureano, Ramón	88.2	12.9	34.7	24.6	31.9	46	25.4	21.8	6.9
LeMahieu, DJ	89.6	3.8	31.6	15	42	55.6	17.4	22.5	4.5
Lowe, Nathaniel	89.8	7.2	36.7	19.1	35.8	48.2	20.2	26.7	5
Machado, Manny	91	15	30.2	30	28.9	40.2	28.9	22	8.9
Maldonado, Martín	88.4	18.1	32.8	27.2	25.5	38.7	31.5	20.9	8.9
Marsh, Brandon	91.3	12.4	37.7	22.3	30.2	45.7	26.8	24.9	2.6
Marte, Ketel	91.1	10.7	30.8	24.5	36.3	45.8	25.2	23	6
Martinez, J.D.	93.4	16.9	41.1	21.9	25	35.6	37	24.3	3.1
Massey, Michael	88.6	19.7	38	32.9	21.6	31.4	30.5	28.1	9.9
McCormick, Chas	88	14.6	38.4	23.5	26.6	42.2	31.1	22.5	4.2
McCutchen, Andrew	89.6	12.3	33.7	24.8	30.6	42.9	27.2	25.2	4.8
McNeil, Jeff	86	14.4	32.1	30.6	30.4	42.2	22.1	25.7	10.1
Meneses, Joey	89.4	9.4	32.9	23.6	36.8	48.1	19.2	25.8	6.8
Merrifield, Whit	85.1	14.4	37.2	30.8	31.4	40.5	25.7	26.1	7.7
Morel, Christopher	92.1	12.4	29.5	24	31.8	42.6	29.5	20.5	7.4
Mountcastle, Ryan	91.4	12	35.9	21.7	33.4	44	26.3	25.1	4.6
Naylor, Josh	89.1	12.3	35.5	25.1	29.7	43.2	25.6	23.8	7.4
Ohtani, Shohei	94.4	13.2	35.6	19.6	30.5	42.6	30.3	22.7	4.5
Olson, Matt	93.7	16.1	31	26.1	27.2	38.7	34.4	20.9	6.1
Ozuna, Marcell	91.8	15.6	34.9	22.6	28.1	39.9	32.4	21.9	5.8
Paredes, Isaac	86.9	22.2	32.4	35.5	24.2	31.6	28.5	24.9	14.9
Pederson, Joc	92.1	15.2	33.5	26.8	21.7	40.1	30.1	23.5	6.3
Peralta, David	89.3	8.2	31.1	20.1	36.6	49.1	21.6	25.3	4
Peña, Jeremy	88	5.5	32.4	18.9	39.1	54.4	18.9	22.9	3.8
Pham, Tommy	92.3	5.7	34.4	16.3	38.7	48.5	21.5	27.6	2.5
Profar, Jurickson	86.5	14.8	37.7	28.6	31.3	40.1	24.1	26.7	9.1
Raley, Luke	91.1	17.3	29.3	26.7	30.6	43.5	27.6	17.2	11.6
Ramirez, Harold	89.1	6.1	29.4	18.7	38.8	55.4	19.3	20.8	4.6
Ramírez, José	90	18	36.8	31.3	26.5	34.9	28.5	26.3	10.3
Realmuto, J.T.	89.8	16.7	36.2	27.5	27	37.6	28.9	24.2	9.3
Renfroe, Hunter	88.3	15	29.5	29.5	31.6	42.8	25.3	21.8	10.1
Rengifo, Luis	89.1	11	29.7	24.7	34.8	46.8	28.2	19	6
Reynolds, Bryan	90.9	10.9	36.9	19.5	32.4	44.1	28.7	24	3.2
Riley, Austin	92.3	13.5	35.2	24	28.6	41.1	28.6	23.8	6.5
Rodriguez, Julio	92.7	8.5	31.8	20	36.4	47.6	24.5	23.3	4.6
Rojas, Miguel	87.3	11	33.4	28.8	35.5	46.2	20.9	26.2	6.7
Rosario, Amed	88.3	7.6	33.8	22	38.2	48.1	18.1	27.1	6.8
Rosario, Eddie	88.6	14.5	35.9	26.2	29.2	39.8	28.4	25.6	6.1
Ruiz, Esteury	82.7	9.9	32.7	22.8	38	50.7	20.3	21.4	7.6
Ruiz, Keibert	87.4	15.3	39.4	29.8	29.3	38.8	24.6	26.1	10.5
Rutschman, Adley	88.4	12.6	37	23.8	30.3	42.9	26	26.4	4.7
Santana, Carlos	88.8	12.8	31.3	28.2	34.7	43.3	24.2	22.2	10.2
Smith, Will	89.3	15.6	37.5	29.5	27.1	37.7	32.3	24	5.9
Solano, Donovan	90.2	13.1	43.1	22	30.2	41	23.1	31.9	4.1
Stanton, Giancarlo	93.3	12.5	27.4	26.6	32.3	42.7	26.2	22.2	8.9
Soto, Juan	93.2	6.7	28.5	17.1	35.5	51.9	25.2	18.9	4
Steer, Spencer	88.7	15.3	35.3	29.5	28	38	27.5	24.6	9.8
Stephenson, Tyler	89.4	8.9	33.5	17.2	34.4	48.9	23.3	24.5	3.3
Stott, Bryson	88.1	10.1	36.4	25.1	35.6	47.4	23.1	25.3	4.3
Straw, Myles	86.3	9.4	34	28.4	35.3	48.5	20.7	25.5	5.3
Suzuki, Seiya	91.4	10.8	36.5	20.2	30.6	43.6	24	28.6	3.8
Suárez, Eugenio	90.3	18.9	37.7	31.6	22.3	34.2	34.4	25.1	6.3
Swanson, Dansby	89.3	13	35.1	22.8	32.9	44.1	25.2	24.2	6.5
Sánchez, Jesús	90.4	5.6	32.9	12.9	36.1	49.8	18	26.3	5.9
Tatis Jr., Fernando	91.9	11	31.5	20.8	32.4	47.7	25.1	21.2	5.9
Tauchman, Mike	88.4	8.1	37.6	18.4	35.7	47.1	19.6	29.8	3.5
Taveras, Leody	90.1	10.2	35.2	21.4	34.4	45.9	22.7	26.4	5
Thomas, Alek	88.9	2.2	28.3	15.7	43.7	56	16.7	23.2	4.1
Thomas, Lane	88.5	10.8	36.8	22.9	31.2	43.4	23.5	25.9	7.2
Torkelson, Spencer	91.8	17.1	33.2	29.3	26.4	33.9	31.6	24.5	10
Tovar, Ezequiel	88	12.6	36.4	24.5	28.8	43.1	26.4	26.2	4.3
Turang, Brice	85.5	12.6	34.3	28.9	31.4	42.5	25.1	24.1	8.3
Turner, Justin	89.5	16.5	36.8	29.7	27.3	35.7	33	25.1	6.2
Turner, Trea	89.9	13	36.1	26.7	30.4	40.2	30.6	23.7	5.5
Verdugo, Alex	89.2	8.8	35.4	23.6	33.6	44.8	23.1	27.1	5
Vierling, Matt	89.1	9.1	32.2	21.7	38.2	49.1	20.3	23.8	6.8
Walker, Jordan	89.4	10.2	33.6	21.4	33.3	46.9	22.6	25.2	5.3
Ward, Taylor	90.7	14.3	34	27.7	31.9	41.1	32.3	22	4.6
Wiemer Jr., Joey	89.3	10.5	28.9	25.7	37.9	46.6	28.9	17.4	7.1
Witt Jr., Bobby	90.7	15.7	34.4	25.9	30.1	37.6	28.4	25.9	8.1
Wong, Connor	89.1	15.5	34	28.2	28.2	43.6	25.3	22.4	8.7
	avg Exit Velo	avg Launch Angl	Sweet Spot %	Under %	Topped %	Ground Ball %	Fly Ball %	Line Drive %	Pop Up %
Average	89.46934307	11.67226277	33.9540146	23.70656934	32.6350365	44.48248175	25.11751825	24.12773723	6.274264706

Figure 3 (Created by Researcher) The data collected from Slap Swing Hitters.

III. Research Methods

This research paper will use information found online, such as theories, ideas, information and statistics to formulate a clear response. The research method applied for this paper is very simple as this paper uses previously discovered theories and ideologies to implicate the topic. Data is then collected for further analysis to formulate a proper and information conclusion.

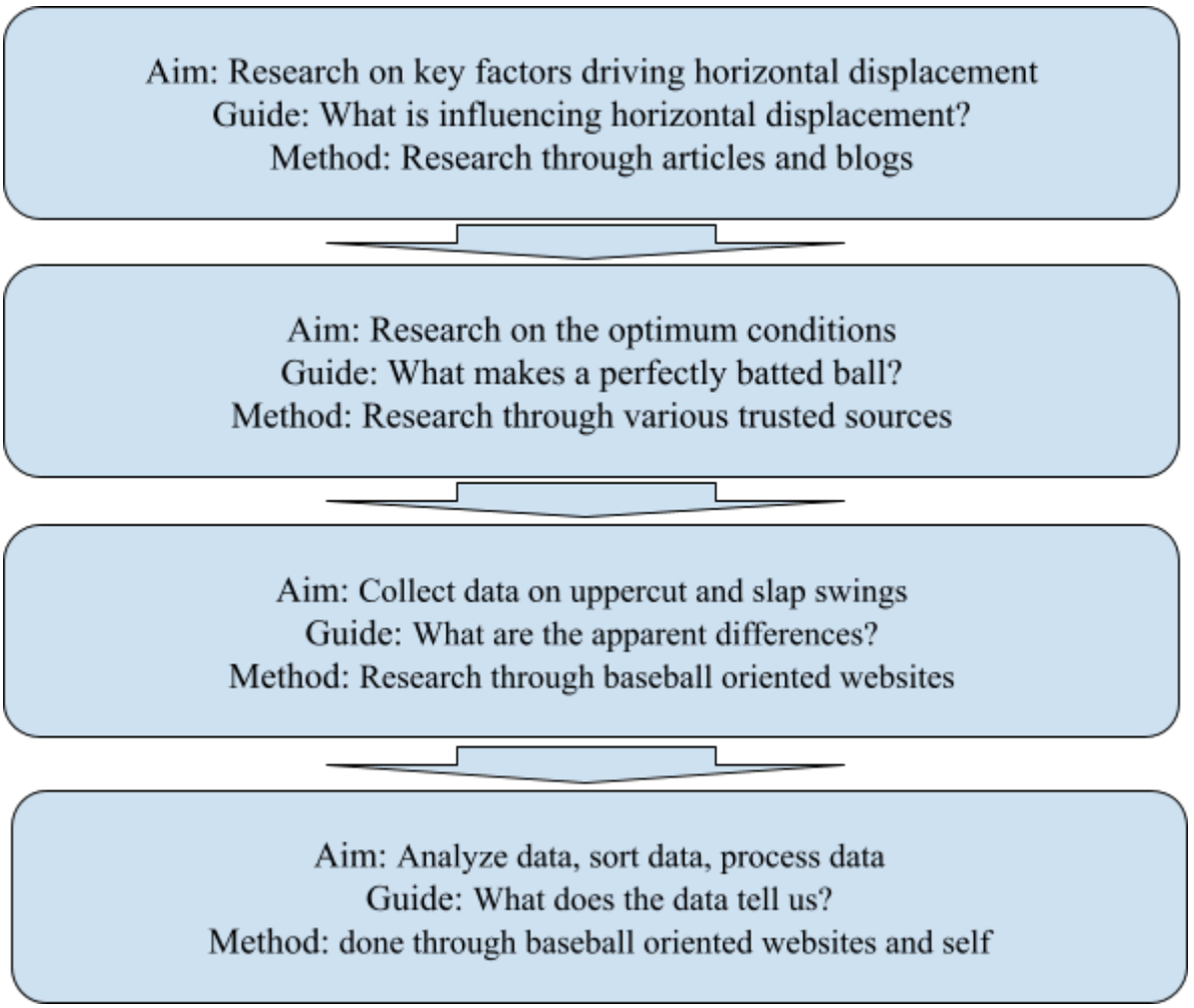

Figure 4 (Created by Researcher) The research plan from stage to stage.

IV. Analysis and Results

The factors that are involved in hitting a baseball are vast, the different approach players can take in their swinging path may decide a lot about their end result. In the uppercut path swing, players lean downwards on the backside of their body to bring the bat down. In the slap-path swing, players bring their bat directly to the ball or dip their bat below the ball. Through data collected, four comparisons have been made between equally successful hitters. Of these comparisons, Immediate attention would be brought to the ground ball and fly ball percentage rates. Players using the uppercut swing path have a greater flyball rate in three out of the four pairs made (*Baseball Science 101: The Physics of Hitting a Home Run*, 2017). Players using the uppercut swing path also have a greater groundball rate in three out of the four samples. Ground balls tend to have a maximum horizontal displacement of 40 meters whilst fly balls have a maximum horizontal displacement of 155 meters. Results also show slap swing hitters are more likely to hit the top of the ball, uppercut

swing hitters are more likely to hit the bottom of the ball. These statistics incline to uppercut swing hitter having an advantage over slap wing hitter in terms of horizontal displacement of the ball after impact. In the data sets featuring players with 400+ plate appearances, exit velocity was not an apparent factor; however, the launch angle is shown to have a 4 degree difference between the uppercut swing and the slap swing, with the uppercut swing having the upside. This may be the deciding factor between the two different swings

V. Conclusion and Suggestions

(I) Conclusion

How do swing paths influence horizontal displacement in hitting a baseball?

The Uppercut swing would give the batter a greater advantage in creating greater horizontal displacement as placing the bat path near parallel to the 28 degree launch angle can provide a better plane of contact with the ball, giving the ball a better launch angle for the adequate time the ball needs to fly and have a great horizontal displacement. The exit velocities didn't vary much, with the uppercut swing having a slight advantage. The results have shown the uppercut swing being more friendly to batters chasing greater horizontal displacement.

From this study, it can be shown that the uppercut swing can bring more horizontal displacement to the ball through the difference in swing path causing a greater launch angle to occur. This may benefit a lot of youth baseball players, middle school baseball players, and highschool baseball players who want to add more power. This demonstrates how horizontal displacement can be increased and may be of much help to baseball players all over the world.

(II) Suggestions

Baseball players are trending to dependency on personal training staff and other supporting members to help with personal development. This may not be necessary as repetitions and correct ideologies are important, comfort is often the most important factor to a great hitter. Forcing a player and their unique anatomy to conform to the anatomy of another is inefficient and ineffective. If the uppercut swing doesn't bring greater horizontal displacement to the ball, don't force it.

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