Earlier this summer, I wanted to test some ideas regarding both length and swingweight using some very controlled measures. This is only Part One of a three part test, but I wanted to share the thought process with you in order to gain an appreciation of the custom fitting process and show that it does takes time and diligence to find a winning combination. This data took approximately 3 hours to collect and the work is going toward an upcoming fitting book.

From evaluating clubheads at the range, my personal favorite by far has been the new Power Play System Q^2 because of the look, sound and performance. I set this experiment up using the Club Conex system because of the interchangeability of shafts and maintaining consistency using the same exact head. In addition, three shafts were used (Golf Gear CT-58) as I had plenty of these on hand and had used them in previous tests This was a private label shaft that the best I can find that is close to it is the Apollo Masterflex HP-55.

The purpose of this part of the experiment is to see what happens to ball speed when length and swingweight changes, while keeping pretty much everything else the same. A launch monitor was used to capture the ball speed that should have factored in centeredness of contact. To reduce fatigue and create enough of a change, only two screw weights (3.5g and 12g) were selected as they provided the greatest differential. Below is the matrix of what would be tested:

ID #	Head grams	Weight #1	Weight #2	Length	Swing Weight	Total Weight	Calc. MOI	Frequency CPM
1	201	3.5	3.5	45	D0	310	2887	242
2	210	3.5	12	45	D6	319	3005	236
3	219	12	12	45	E1	328	3122	231
4	201	3.5	3.5	44	C5	310	2760	255
5	210	3.5	12	44	D1	319	2873	249
6	219	12	12	44	D6	328	2985	245
7	201	3.5	3.5	43	C1	310	2636	255
8	210	3.5	12	43	C6	319	2744	250
9	219	12	12	43	D1	328	2851	245

The great thing about heads with adjustable weighting allows for some unique combinations that are not normally found off-the-rack. For instance, try to find a Men's driver less than 45" or try to find a driver with a swingweight higher or lower than the normal range (D0 - D2) – you won't. True custom fitting requires finding what works best for the golfer regardless if it is conventional or not.

Each combination was hit into a net and the ball velocity recorded by a launch monitor. The bad shots were deleted from the data, while a minimum total of 3-4 good shots were used for the average. Some clubs were retested later during the fitting to make sure that the results were consistent to account for variations in swinging the club and fatigue. The ball speed of each club was recorded in the chart below and put into order from highest to lowest to determine any common denominators.

ID #	Head grams	Weight #1	Weight #2	Length	Swing Weight	Total Weight	Calc. MOI	Frequency CPM	Ball Speed
4	201	3.5	3.5	44	C5	310	2760	255	144.8
5	210	3.5	12	44	D1	319	2873	249	144.3
7	201	3.5	3.5	43	C1	310	2636	255	143.2
6	219	12	12	44	D6	328	2985	245	142.2
1	201	3.5	3.5	45	D0	310	2887	242	140.5
8	210	3.5	12	43	C6	319	2744	250	140.4
2	210	3.5	12	45	D6	319	3005	236	139.6
3	219	12	12	45	E1	328	3122	231	136.5
9	219	12	12	43	D1	328	2851	245	135.0

The most obvious common denominator was that the 44" clubs demonstrated the highest ball speed on average. Ball speed and swing speed are two different things. Although swing speed was not measured, the longer club should have increased potential distance with an increase of clubhead speed. However, this was not the case in terms of actual results. The ball speed of the 44" driver could have very well been higher as a result of solidness of contact or striking the ball more in the center of the face. It should be noted that ball speed is only one component of overall distance as direction and trajectory also are very important factors.

Secondly, the heavier the head, the result was generally a lower ball speed. Remember $E = MV^2$ from middle school science class? Both velocity and mass are important, but the velocity of the club squared is a slightly more important factor than the mass of the head. The lighter swingweight of the 44" driver (#4) or even the lighter overall weight could have been the perpetrator in generating the highest ball velocity of the nine clubs in the matrix.

In addition, a control driver was used as well to prove another important fact and that was the effect of additional shaft weight. The same Power Play System Q^2 head was used, but the shaft was one weighing twice as much (Apollo Stepped Standard S-flex), of which the results are below.

ID #	Head grams	Weight #1	Weight #2	Length	Swing Weight	Total Weight	Calc. MOI	Frequency CPM	Ball Speed
10	201	3.5	3.5	44	D3	375	3048	265	131.7

Just for your reference, an increase of 1 mph in clubhead speed for a driver results into approximately a 2.5 increase of length. Since we measured ball speed instead of clubhead speed a 1 mph change in ball speed results into approximate 1.8 yards. The difference between Club #4 and #1 was a 13.1 mph ball speed difference or approximately 23 yard difference, even though they are the exact same length. Obviously shaft weight has a significant factor in overall distance.

Another control driver was used, although this was not one using the Club Conex system, rather one of the drivers we used for recording the sound you hear on our internet site. The reason why this club was chosen is it had the same Golf Gear CT-58 shaft, plus the club was longer in length and lighter in overall weight. The head on this particular club was the Synchron SP-6 10° driver.

ID #	Head grams	Weight #1	Weight #2	Length	Swing Weight	Total Weight	Calc. MOI	Frequency CPM	Ball Speed
11	196	0	0	45.75	C8	305	2917	234	142.5

Although this club did not yield the highest ball speed, it showed what a lighter swingweight and overall weight can do to increasing ball speed using the same shaft, but by using a lighter head weight. To experiment even further, the SP-6 driver was added a 27g counterbalance to illustrate a point about swingweight and overall weight. The counterbalance was a brass door hinge that could be inserted into the vent cap of the grip and easily removed. This was a cheap $2 experiment, instead of spending money on a pre-made counterbalance. Below are the results:

ID #	Head grams	Weight #1	Weight #2	Length	Swing Weight	Total Weight	Calc. MOI	Frequency CPM	Ball Speed
11C	196	0	0	45.75	C1	332	2919	234	150.1

By adding the counterbalance, it increased the overall weight by 27g but reduced the swingweight by 7 points. However, since the weight is positioned in the person's hands, it has little effect to the MOI of the club and honestly cannot be felt. But look what happens to the ball speed – it increased by 7.6mph or theoretically 13.5 yards which is quite significant. I had hit this club with the counterbalance before at the range and with similar results.

If the use of a counterbalance worked this well in one club, how might it react into the drivers that showed the highest ball speeds? Club #4 and #5 had the counterbalance added to see what change would be made to the ball speed. The ID# with the C denoted the counterbalanced club.

ID #	Head grams	Weight #1	Weight #2	Length	Swing Weight	Total Weight	Calc. MOI	Frequency CPM	Ball Speed
4	201	3.5	3.5	44	C5	310	2760	255	144.8
4C	201	3.5	3.5	44	B8	337	2762	255	144.1
5	210	3.5	12	44	D1	319	2873	249	144.3
5C	210	3.5	12	44	C4	346	2875	249	137.9

In both cases, the ball speed went down and did not show the same results as ID#11C. Therefore, counterbalancing can help in some, but not all conditions. This may be more important to see how overall weight and weight distribution (not swingweight) control how well a golfer releases the club upon impact.

From going out to the range a few times and experimenting with different shafts (again using the same Club Conex system), one combination demonstrated the most distance and consistency. This was based on observing flight and did not use a launch monitor to achieve the conclusion. That shaft was the Aldila NV65 S-flex at 45" with the Power Play System Q^2 head. So it would be interested to see in fact what those numbers would indicate. The launch monitor results are as follows using both the different screw weights and adding the counterbalance:

ID #	Head grams	Weight #1	Weight #2	Length	Swing Weight	Total Weight	Calc. MOI	Frequency CPM	Ball Speed
12	201	3.5	3.5	45	D2	321	2917	252	156.1
13	210	3.5	12	45	D8	330	3035	246	153.5
14	219	12	12	45	E3	339	3152	241	151.8
12C	201	3.5	3.5	45	C5	348	2919	252	151.8
1	201	3.5	3.5	45	D0	310	2887	242	140.5

Notice how high an increase of ball speed is a result of a shaft change comparing ID #12 with #1 (same 45", head weight, swingweight and similar MOI) . The only significant difference could have been in shaft and/or shaft flex. Remember, in club fitting sometimes all variables will not be exact because of all the possibilities and probabilities possible – and no one has that much money to invest into demo clubs.

Regarding the Aldila NV65 S-flex in the Power Play System Q^2 head, as mentioned previously when the head weights and swingweights increased, the ball speed went down. However, all the ball speeds exceeded 150 mph, while the only other club to exhibit this was #11C. One other thing to notice as possible the common denominator(s) was the MOI and the Total Weight columns.

ID #	Head grams	Weight #1	Weight #2	Length	Swing Weight	Total Weight	Calc. MOI	Frequency CPM	Ball Speed
12	201	3.5	3.5	45	D2	321	2917	252	156.1
13	210	3.5	12	45	D8	330	3035	246	153.5
14	219	12	12	45	E3	339	3152	241	151.8
12C	201	3.5	3.5	45	C5	348	2919	252	151.8
11C	196	0	0	45.75	C1	332	2919	234	150.1

Now, it is important to remember that as much as I controlled each variable, it is still based on human testing over the course of three hours and only one day of actual testing. You can draw your own conclusions from the data so far. That leads us to then next parts of the test.

Part 2 – Watch ball flight at the driving range using ID# 1- 12 and not rely solely on ball speed. Make comments after each three shots to provide distance, height, group accuracy / repeatability and solidness of contact. Rank the clubs in order as they are fresh in the mind.

The following day, headed to the ranged armed with tested clubs, wrench, extra screws, notepad, pen and master sheet (stating ID#, length and screw weight and position). A total of three shots with each club, recorded, then moved on to the next club in sequential ID#. Here is a brief conclusion of each club.

#1 – Very straight, medium height
#2 – Not quite as straight as #1, but slightly higher ball flight
#3 – Short and high right
#4 – Long, very consistent with a slight draw
#5 – Long, but with slight pull, best feeling so far (#1-5)
#6 – High, short, inconsistent
#7 – Longest, straightest (of #1-7), high
#8 – Straight, lower than #7
#9 – Slight pull tendency and generally inconsistent
#10 – left in office
#11 – Long, high
#11C – Longest (of #1-11), but inconsistent
#12 – Longest and straightest by far
#12C – Straight, but shorter with the counterbalance
#13 – Almost as long as #12, but slight fade with 12g weight in toe – shifted the 12g to heel and it straightened it out – hammered - best feeling!
#14 – Inconsistent and with a slight fade bias

After going back and re-hitting the favorites, the Top 6 Ranking were #13, #12, #4, #5, #11 and #7 based on distance, consistency and feel at the range that day.

ID #	Head grams	Weight #1	Weight #2	Length	Swing Weight	Total Weight	Calc. MOI	Frequency CPM	Ball Speed
13	210	3.5	12	45	D8	330	3035	246	153.5
12	201	3.5	3.5	45	D2	321	2917	252	156.1
4	201	3.5	3.5	44	C5	310	2760	255	144.8
5	210	3.5	12	44	D1	319	2873	249	144.3
11	196	0	0	45.75	C8	305	2917	234	142.5
7	201	3.5	3.5	43	C1	310	2636	255	143.2

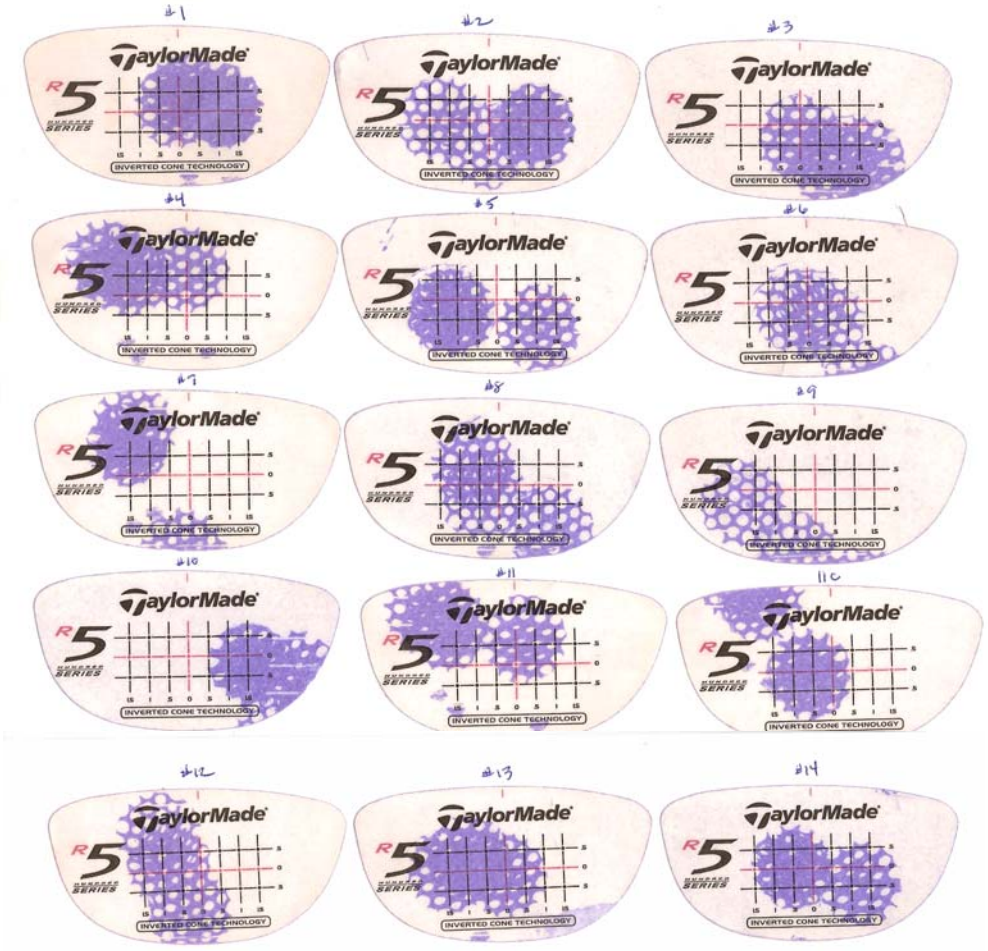
All these driver combinations produced very good results, yet the lengths, swingweights, etc. are varied. There are more than one correct clubs that a fitter can provide a customer as long as they have several demo clubs of various parameters, plus can observe ball flight. The customer can narrow it down from there for feel.

The surprising ones were the #4 and #7, which had a much lighter swingweight than the norm, even for women, but produced very good results. Maybe this is why so many men hit their wife's driver well, but their ego won't allow them to play with it. Perhaps, the lighter swingweight resulted into a stiffer flex and compensated for it. The clubs at the same length, but heavier (#6 and #9) were some of the worst performers. All the models with two 12g weights produced inconsistent results, even though the head would have had a higher MOI (Moment of Inertia). But realize the extra weight in the rear might have also contributed to the higher ball flight (remember some were fades) thus the shorter distance.

Part 3 – This is to be a blind test by hitting into a net to avoid seeing ball flight and then possibly compensating for it. No launch monitor will be used for this test. However we will use impact decals on face to see solidness of contact. (I had an old roll of TaylorMade labels that I didn't want to go to waste)

This is the third day of testing within a 5 day timeline to avoid fatigue, but also to avoid too long a period in which the swing could change. The order of clubs were mixed up, yet labeled clearly after each group of three shots.

Some of the conclusions by examining the pattern and the relationship of the pattern to the center of the face correlated in most cases to the launch monitor results and examining ball flight at the range. The goal is to have the grouping on top of one another plus in the middle of the face/impact label.



45” - D0 CT-58 Shaft	45” - D6 CT-58 Shaft	45” - E1 CT-58 Shaft	Row #1
44” - C5 CT-58 Shaft	44” - D1 CT-58 Shaft	44” - D6 CT-58 Shaft	Row #2
43” - C1 CT-58 Shaft	43” - C6 CT-58 Shaft	43” - D1 CT-58 Shaft	Row #3
44” - D3 Steel Shaft	46” - C8 CT-58 Shaft	46” - C1 Counterbalance CT-58 Shaft	Row #4
45” - D2 NV65 Shaft	45” - D8 NV65 Shaft	45” - E3 NV65 Shaft	Row #5

First, the steel shaft (#10) was the worst as far as impact as all shots were low and toward the heel. From a swingweight stand point (examine Rows #1, 2, 3 & 5), by increasing the weight, consistently the impact went from higher toward the toe and gradually became lower and more toward the heel. This is a unique phenomenon that occurred regardless of length. One could conclude that possibly the higher swingweight caused the balance of the swing to shift forward as a result of the momentum of the club, rather than having the golfer being back on the heels at impact.

From a length standpoint, there was a definite correlation. Club #11 was the longest and impact was routinely made higher up the face, while Row #3 (the 43" drivers) had many impact made low on the face. Why? Your height doesn't change while you keep your hands in relatively the same place. Therefore if you have a club that is too short, it will be hard to get down to the ball without adjusting the stance. Remember off-center shots will affect distance. Hitting high or low on the face, as well as toward the heel or toe would cause the clubhead to twist and effective loose energy as indicated by the reduced ball speed as witnessed from part one of the test.

In this particular case, the 45" produced the best all-around length for consistent contact on the center of the face as long as swingweight was increased slightly and the shaft was not too flexible. Using all three tests, the best performer using ball speed (day one), feel, distance and dispersion (day two), and tightness of shot pattern in relationship to the face (day three) would conclude #13 to be best. Even though the length is the most common found in a driver today, the swingweight is nowhere to be found in an off-the-rack club.

It took accumulatively 5 hours over 3 day period to complete this test just to find the right length and swingweight, even though these all could have been combined at the same time at an outdoor range with a portable launch monitor. Very few club fitting shops are going to be able to offer this much variety of lengths or swingweights. Even if they did, how much are they going to charge and is the customer willing to pay that amount. Although there was a number of the drivers that hit the ball reasonably well, this just goes to show that club fitting takes time to get a superb fit.

Now we can take some time (and yes money) to try to find a shaft that might perform better than #13…