How Valuable is Strike One?

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How many times have we all heard announcers and pitching coaches emphatically assert "The best pitch in baseball is strike one!" It is easy to find this quote attributed to many people, but the one who I think did the most to bring it to prominence was Ray Miller, pitching coach with Earl Weaver and Joe Altobelli in Baltimore, Jim Leyland in Pittsburgh and then two more stints in Baltimore.

This type of assertion is just the sort of thing that inspires baseball researchers to look more deeply and there have been several studies on the effect of the count and various aspects of pitch sequence (Stanley Katz in the 1986 BRJ, Tom Tippett in the DiamondMind newsletter [http://www.diamond-mind.com/newsletter/en010629.htm#si], Phil Birnbaum in By The Numbers [http://www.philbirnbaum.com/btn2000-02.pdf], Craig Burley in the Hardball Times [http://www.hardballtimes.com/main/article/the-importance-of-strike-one-part-two/ and http://www.hardballtimes.com/main/article/the-importance-of-strike-one-part-one/], Tom Tango [http://www.insidethebook.com/ee/index.php/site/comments/hitting_by_count/]). As expected, these previous efforts have used a variety of approaches and perhaps more importantly, a variety of data sets, as follows in Table 1:

Table 1. Data sets used in previous studies on count and pitch sequence
Katz: 3200 plate appearances, 11,000 pitches, approximately **42** games.
Tipppett: Full 2000 season (**2429** games) with pitcher batting excluded
Birnbaum: 1988 AL (**1131** games)
Burley: Full 2003 season (**2430** games) with pitcher batting excluded
Tango: Full 2000-2004 seasons (**12,142** games)

Table 1A. Data used in the current study
Full 1988-2006 seasons, minus 1999 (**40374**)
Games with pitch data: 39345 (97.5%). Early seasons have incomplete pitch data.
Plate Appearances with pitch data*: 2,977,044
Total pitches in these appearances: 11,052,212

*Not included are sacrifice bunts, intentional walks or appearances that end an inning with an out on the bases, such as caught stealing. All games from 2000 to 2006 have pitch data for all games.

As I began working on this presentation, I quickly discovered that there are many more facets to the topic than were immediately apparent, at least to me. Some are rather subtle. Of course, the first pitch does matter, but the progression through the count during a plate appearance is also very important and I have made some discoveries that surprised me and hopefully will intrigue you.

The starting point for most pitch analyses is a summary of batting performance on each of the 12 different counts. Table 2 has that information along with the percentage of time that plate appearances were concluded on the indicated count.

Table 2. Batting performance for all possible final counts

Balls	Strikes	BA	OA	SA	PA %
0	0	.328	.333	.515	13.3
1	0	.330	.330	.534	8.2
2	0	.343	.342	.595	3.0
3	0	.376	.930	.730	2.0
All Balls	0	.331	.377	.533	26.4
0	1	.313	.321	.469	8.6
1	1	.320	.323	.491	8.8
2	1	.331	.331	.531	5.8
3	1	.346	.678	.601	5.1
All Balls	1	.323	.388	.504	28.2
0	2	.157	.167	.226	7.2
1	2	.174	.181	.255	13.4
2	2	.193	.197	.291	12.7
3	2	.228	.467	.370	12.1
All Balls	2	.188	.260	.284	45.4

There are several striking features to this table, the most dramatic one being the effect of having two strikes. For a given number of strikes, batting performance by all three of the traditional measures improves for each additional ball. Conversely, for a given number of balls, batting performance clearly declines for each additional strike. However, the largest differences by far are seen when the final count progresses from strike 1 to strike 2 (highlighted in red). Remember that the title of this presentation has to do with strike one, but one of my first conclusions from this data that perhaps the most important part of strike one is that it puts you on the path to get strike two, and that it is strike two which matters so much more. I will return to this point in a moment. The 12 final counts occur with very different frequencies, with the low ball counts predominating, perhaps surprisingly (highlighted in yellow). There is a predominance of strike 2 situations (45.4%). This is in spite of the fact that there are a large number of 0-0 counts, which nearly match the most frequent category (1-2 counts).

One of the most important consequences of sophisticated Sabermetric study during the last 30 years, with major contributions from Pete Palmer, is the realization that these three traditional measures of batting performance don't tell us as much as we would like. In place of these averages, it has become clear that expressing the data in terms of run scoring is much more meaningful. This table also points up another aspect to this dilemma, which is that the twelve categories occur with greatly different frequencies, making comparisons even harder. Therefore, I used Pete's Linear Weights formula to convert the batting data to equivalent runs, which is explicitly per plate appearance. I then went one step further and normalized the Linear Weights results to the equivalent of

500 plate appearances, which is a good representation of a fulltime batter (as a point of comparison, I note that it takes 502 plate appearances to qualify for the batting championship). The results are in Table 2A, which is the same as before with the addition of what I called LW500, or Linear Weights contribution per 500 plate appearances.

Table 2A. Batting performance for each final count, including LW500

Balls	Strikes	BA	OA	SA	PA	PA %	LW500
0	0	.328	.333	.515	394,692	13.3	15.4
1	0	.330	.330	.534	244,613	8.2	17.7
2	0	.343	.342	.595	88,740	3.0	29.4
3	0	.376	.930	.730	58,553	2.0	145.6
All Balls	0	.331	.377	.533	786,598	26.4	27.4
0	1	.313	.321	.469	255,045	8.6	5.9
1	1	.320	.323	.491	262,380	8.8	9.7
2	1	.331	.331	.531	171,954	5.8	17.4
3	1	.346	.678	.601	150,539	5.1	95.1
All Balls	1	.323	.388	.504	839,918	28.2	25.4
0	2	.157	.167	.226	213,933	7.2	-62.8
1	2	.174	.181	.255	398,228	13.4	-55.7
2	2	.193	.197	.291	378,330	12.7	-47.1
3	2	.228	.467	.370	360,037	12.1	28.8
All Balls	2	.188	.260	.284	1,350,528	45.4	-31.9

Linear weights values are adjusted to have a net value of 0 for a given season so positive numbers mean contributing to scoring and negative numbers mean lowering the chance of scoring. However, the full Linear Weights formula does not have complete applicability here, especially since there are components of stolen bases and caught stealing that cannot meaningfully be assigned to a given count. The weighted average of LW500 for my data was 8.2, not 0, so all values have been corrected accordingly by this amount. However, since almost all of my use of LW500 will be to compare different values, this adjustment has no net effect on my conclusions.

The general rule is that the addition of 10 runs over the course of a season is equivalent to one extra win and the subtraction of 10 runs is equivalent to one extra loss. Assuming that the LW500 column is a reasonable approximation for a full-time player, we can revisit the earlier conclusions in terms of runs and wins. Once again, a batter with one strike in his final count is disadvantaged compared to the corresponding zero strike situations and having two strikes is always much more damaging in terms of run potential than having one strike. A specific example of this effect may be seen by examining the results on the 0-2 count. The value of -62.8 for LW500 can be read as saying that a batter

who had 500 plate appearances for the year that ended on a count of 0-2 would cost his team 62.8 runs or 6.28 wins, compared to the average. Comparing this hypothetical sad sack to the batter who puts the ball in play on the first pitch (or was hit by that pitch) in each of his 500 plate appearances (the 0-0 count), we see a difference of 78.2 runs (15.4 – [-62.8]) so the "0-2 batter" costs his team 7.82 wins compared to the "0-0" batter.

It may be surprising to see that all of the three ball situations are positive for batters, with even the 3-2 count favoring the batter. If our hypothetical batter ended all of his 500 plate appearances on a 3-0 count, then he would help his team to more than 14 extra wins a year. Of course, we can't lose sight of the fact that these situations are only 2% of all situations and we must also remember that only the best hitters will be given the green light on 3-0, so that helps make the offensive results even higher. The LW500 calculation will be used in all the remaining data slides of this presentation.

Now to the main question in my title: how important is strike one? It turns out to be a little trickier to answer than it might first appear. For example, how do we treat plate appearances in which there is only one pitch? By convention, a ball put in play is counted as a strike, but does that fit the meaning of Ray Miller's proclamation? Table 3 gives the first pass at answering this question, with results for all appearances which did not end on the first pitch, but all other 11 counts are combined

Table 3. Batting results for first pitch balls and strikes

First Pitch	BA	OA	Sa	PA	PA%	LW500
Ball	.277	.380	.443	1,259,532	42.3	16.3
All Strikes	.232	.274	.352	1,320,903	44.4	-20.2

It certainly appears that Miller is correct; a pitcher would be well-advised to get the first pitch over for a strike, with an LW500 difference of 3.6 wins. What about the omitted categories? There are two other choices for the first pitch, namely put in play or hit batter. In conventional pitch total tabulations, these are recorded as a strike and a ball, respectively. If they are included, we get the results in Table 4 ("X" is the Retrosheet pitch notation for a ball in play and "H" is used for pitches that hit the batter).

Table 4. Batting results for all first pitches, including balls in play

First Pitch	BA	OA	Sa	PA	PA%	LW500
Ball + HBP	.277	.383	.443	1,264,506	42.5	16.9
All Strikes + X	.255	.286	.391	1,710,618	57.5	-12.5

Even with this expanded definition of a strike , there is still an advantage to the pitcher for a first pitch strike compared to a first pitch ball, but the increase is diminished from a change in LW500 of -36.5 to -29.4, a benefit of about 0.7 wins per year. Remember that the X plus H first pitches constitute 13.3% of all plate appearances. It is clear that hitting the first pitch is an advantage to the batter, so I decided to expand the strike category into its four subcomponents, as shown in Table 5.

Table 5. Batting result for each type of first pitch.

First Pitch	BA	OA	Sa	PA	PA %	LW500
S	.211	.253	.326	181,121	6.1	-28.1
C	.234	.277	.350	818,320	27.5	-20.1
F	.240	.280	.373	321,462	10.8	-16.0
X	.328	.324	.515	389,715	13.1	13.6

These are remarkable differences and all the BA are statistically different from each other. Putting the first pitch into play (or getting hit by it) is of great value to the batter whereas swinging and missing at the first pitch bodes very ill for him. Called strikes and foul balls are much less damaging. It would be tempting to amend Miller's comment to be something like: "The best pitch is strike one, unless you make it too hittable". Once again, note the frequencies of these events. The three swinging results add up to 30% of all plate appearances, with the swinging strike the least frequent by far. In the modern high strikeout era, that may be surprising.

To finish off this first view of the first pitch, I prepared Table 5A, which is just Table 5 with the other two first pitch results, so the data for all 6 possibilities are together.

Table 5A. Batting results for each type of first pitch, including balls in play

First Pitch	BA	OA	Sa	PA	PA %	LW500
S	.211	.253	.326	181,121	6.1	-28.1
C	.234	.277	.350	818,320	27.5	-20.1
F	.240	.280	.373	321,462	10.8	-16.0
X	.328	.324	.515	389,715	13.1	13.6
B	.277	.380	.443	1,259,532	42.3	16.3
H	.000	1.000	.000	4,974	0.2	156.8

Of course, one question this leads to is how often these 6 pitch results occur at any time during the count, not just on the first pitch. That answer is in Table 6. There are actually seven categories, with the addition of "K". The "K" is an "unknown strike", usually the result of TV or radio issues for the scorers in the earlier years of the data.

Table 6. Frequency of each pitch type at any time.

Pitch	Number	%
X	2,224,995	20.1
F	1,864,671	16.9
S	1,005,295	9.1
C	1,798,044	16.3
K	4,208	0.04
All strikes	6,897,213	62.4
B	4,130,894	37.4
H	24,105	0.2
All balls	4,154,999	37.6
All Pitches	11,052,212	100.0

Comparison to the PA percentages in Table 4 shows that pitchers treat the first pitch differently from later pitches, throwing a much LOWER percentage of strikes on the first one. Table 6 covers all pitches, so if we subtract out the first pitch data, then we get the large difference shown in Table 7.

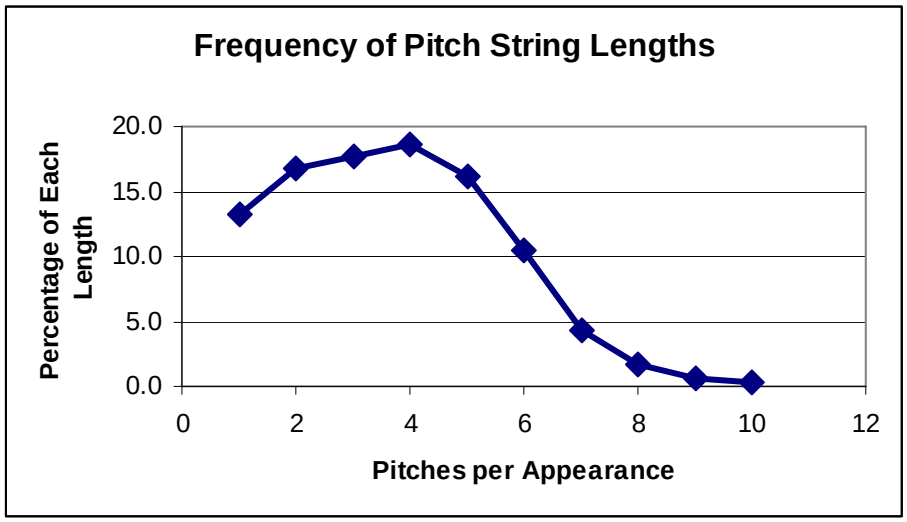
Table 7. Frequency of balls and strikes on first pitch and other pitches

Pitch Type	First Pitch	Not First
All S	57.5	64.2
All B	42.5	35.8

Major League pitchers throw strikes (including balls put in play) just over 60% of the time, but it appears they temper the advice of Ray Miller and do not just try to get a strike at all costs. Pitchers seem to have learned that 0-0 is a good hitting count, so we need to temper Miller's advice a bit more.

One more extension is to consider how many pitches a batter sees in a given plate appearance. Figure 1 presents in graphical form the occurrence of pitch strings of each length, with all cases of 10 or more combined (just under half of those long strings are exactly 10 in length).

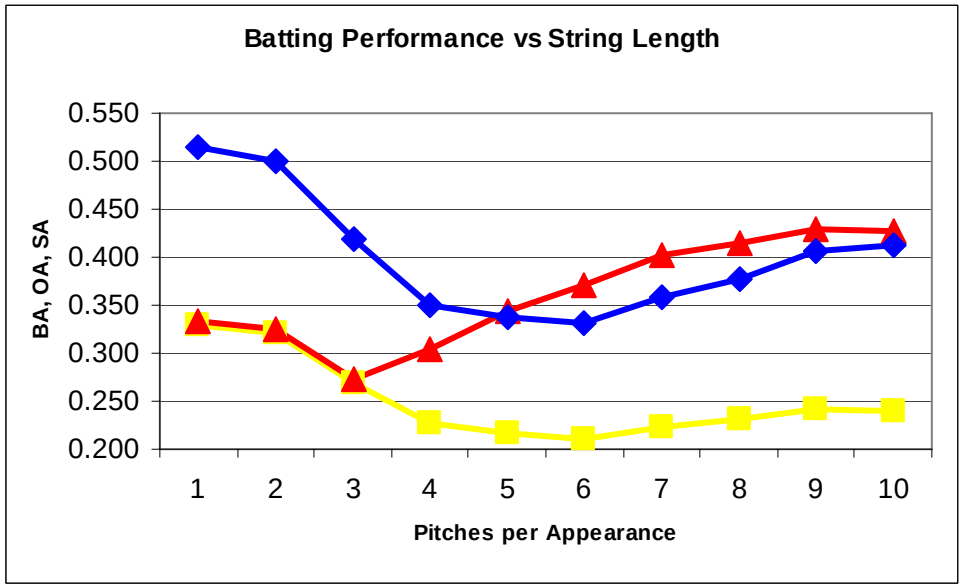
Figure 1. Frequency of each number of pitches in an appearance.



The average is 3.71 pitches per appearance and the distribution is heavily weighted toward the short end. About two thirds of all appearances have four or fewer pitches and over 80% are completed within five pitches.

Is there a relation between the number of pitches and batter performance? Another tidbit of conventional wisdom is that the more pitches are thrown, the better it is for the batters. Figure 2 addresses this point by presenting BA, OA, and SA as a function of the number of pitches.

Figure 2. Batting performance as function of number of pitches per appearance.

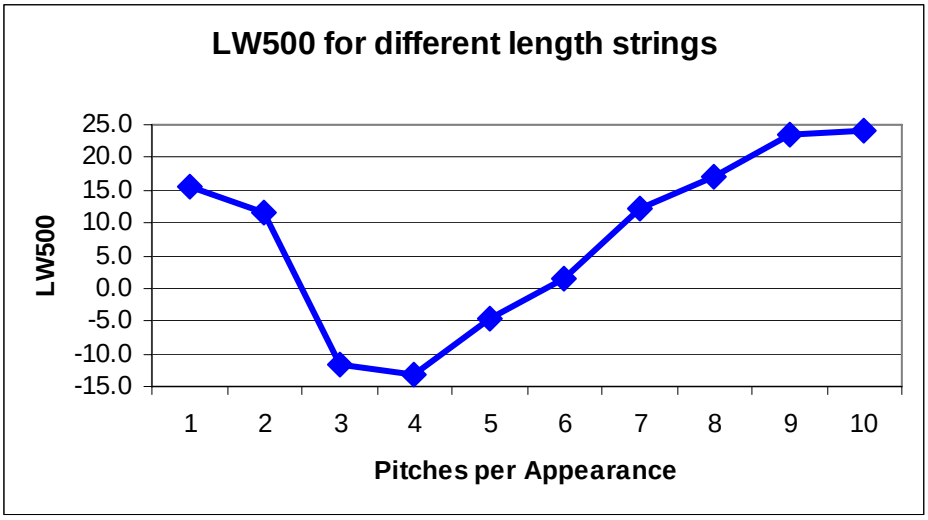


BA and OA are virtually identical for cases of one, two and three pitches. Of course, this makes sense, since hit by pitch are a generally rare event and it is not possible to draw a

walk until at least four pitches are thrown! BA is unquestionably highest for strings of 1 and 2, reinforcing the earlier points about the benefit to the batter in swinging early. Beginning with strings of length 4, the BA and OA diverge dramatically, with BA staying more or less constant, while OA continues to rise. SA follows a more complicated pattern. The highest values are once again seen for the strings of 1 and 2 pitches. A decline follows that, but then it picks up again beginning with length 7 (but remember that strings of 7 or more pitches are only 7% of the total when all are combined). At any rate, the other fairly conventional measure of performance, namely OPS, parallels the SA curve very closely (data not shown).

I also calculated the LW500 for pitch strings of each length and those results are presented in Figure 3.

Figure 3. LW500 for different length pitch strings



This use of Linear Weights has allowed us a surprising insight otherwise not available. The only pitch strings with a negative LW500 are those of length 3, 4 and 5. As you will remember from Figure 1, these are three of the four most frequent lengths, comprising about 52.5% together. Even though the other half of appearances have clearly positive LW500, their combined, weighted average just balances out the results for the strings of 3, 4 and 5 pitches.

Remember that Table 5 showed that a swinging strike was definitely more harmful to a batter than other types of strike 1. That table looked at all counts (other than 0-0 of course) and I was concerned about combining the other 11 since the great variation in performance levels across these counts could be masking some important patterns. I therefore chose to look at all appearances that were resolved on 3-2 counts. These will of course have the most pitches of any count and it gives us the best chance to see if there were a first pitch effect that carried over through the entire plate appearance. In addition this is the only count on which all possible outcomes can occur, since with less than 3

balls there cannot be a walk and with less than 2 strikes, there cannot be a strikeout. As shown in Table 8, there are some very interesting effects.

Table 8. Batting Results for Appearances ending on 3-2 count.

First Pitch	BA	OA	SA	PA	PA%	LW500
All Strikes	.227	.465	.371	151,165	41.9	28.5
Ball	.228	.468	.369	208,872	58.1	29.0
Called Strike	.229	.467	.368	94,428	26.2	28.5
Foul	.238	.469	.398	35,178	9.8	32.3
Swinging Strike	.205	.451	.342	21,333	5.9	22.6

The first point that caught my attention is that the results for “all strikes” and “ball” are virtually identical (and not statistically different), whereas the values for all counts (Table 3) showed a highly significant 45 point difference in BA, .277 vs .232, and corresponding differences in OA and SA. TheLW500 difference was over 36 runs. The next feature of this table to note is that the first pitch in these appearances that end on 3-2 is a ball 58% of the time. Recall that the percentage of ball one over all appearances is 42% (Tables 3 and 4) and that for all pitches at any point in the count over all appearances the ball one percentage is about 37% (Table 6). This means that ball one is a very significant predictor of getting to a 3-2 count. I will expand on that in a moment, but first I wish to discuss the dramatic effect of the type of strike 1 on the ultimate outcome. A called strike one leads to the same 3-2 results as ball one (not statistically different). A first pitch foul helps the 3-2 BA and SA (statistically significant differences), but not OA. A first pitch swing leads to a big drop in the 3-2 outcome by all three averages and LW500. Of course, the rates of occurrence of these three types of first strikes are very different, but the extreme negative effect of the swinging strike is eye-catching. It is also consistent with the harmful effect of a swinging strike over all appearances (Table 5).

It is interesting to consider why a first pitch swing and miss is so detrimental to the batter. Perhaps it indicates a dominance by the pitcher that will carry through the rest of the appearance. On the other hand, it may show that batters have also learned that 0-0 is a good hitting count, so they now take more chances and perhaps expand the strike zone a bit. That strike zone expansion might then carry through the rest of the appearance. There is some evidence to support this conclusion in Table 9, which includes most of the data from Table 8 plus two new columns. These are strikeouts and walks per 38 PA. I chose this number since the average number of PA per team per game over the 19 seasons studied is right around 38.

Table 9. Strikeouts and Walks per 38 Plate Appearances on 3-2 count

First Pitch	BA	OA	SA	LW500	SO38	BB38
All Strikes	.227	.465	.371	28.5	8.3	11.7
Ball	.228	.468	.369	29.0	8.1	11.8
Called Strike	.229	.467	.368	28.5	7.9	11.7
Foul	.238	.469	.398	32.3	8.1	11.5
Swinging Strike	.205	.451	.342	22.6	10.2	11.7
Overall (all counts)					6.2	3.1

Batters who swing and miss at the first pitch are much more likely to end up with a strikeout . Those who take strike one end up striking out less often than those who take ball one! However, they still strike out noticeably more than the overall average. The walk rate is virtually unaffected by the nature of the first pitch and is of course much higher than the overall rate. Taken together, these two points mean that batters who swing and miss at the first pitch and then end up with a full count will either strike out or walk in about 22 of every 38 plate appearances.

There is one more approach to the full count data and that is to look at the various pitch sequences that can result in a 3-2 count. If the first pitch is a ball, then there are six different sequences (in all cases, foul balls with two strikes are ignored):

BBBKK
BBKBK
BBKKB
BKBBK
BKBKB
BKKBB

Where “K” here means any strike, C, S, or F. Conversely, if the first pitch is a strike, then there are four sequences that lead to a 3-2 count:

KBBBK
KBBKB
KBKBB
KKBBB

Once again the “K in this case refers to all strikes of any type. The obvious question is whether or not these different sequences matter. That is, is there a history within a plate appearance that will be reflected in different outcomes? Other researchers have addressed this topic by looking at the count that a batter “passes through” on the way to his final count. Table 10 presents these sequences with batting results in my standard format

Table 10. Batting Performance for Different Paths to 3-2 Count

Sequence	BA	OA	Sa	PA %	LW500
BBBKK	.232	.473	.368	1.21	30.0
BBKBK	.225	.470	.364	0.96	29.0
BBKKB	.229	.464	.379	1.23	29.1
BKBBK	.227	.473	.365	0.92	29.8
BKBKB	.225	.464	.364	1.27	27.5
BKKBB	.227	.465	.374	1.43	28.9
All Ball 1	.228	.468	.369	7.02	29.0
KBBBK	.225	.473	.363	0.84	29.4
KBBKB	.227	.464	.376	1.19	28.7
KBKBB	.232	.466	.378	1.48	29.4
KKBBB	.224	.461	.366	1.58	27.1
All Strike 1	.227	.465	.371	5.08	28.5

As expected, these 10 cases do not occur with equal frequency, although there is more variation when the first pitch is a strike. It is almost twice as common for an appearance to start out 0-2 and end up at 3-2 than it is for an appearance to start with a strike and get to 3-1 before reaching 3-2. By all measures the batting performance in these 10 cases is only slightly different, with the appearances that start out 0-2 leading to the lowest LW500 values by a small margin. The overall consequence of a first pitch ball is virtually indistinguishable from a first pitch strike.

Since I had previously found that a swinging strike one had such a significantly different impact from a called or foul ball strike one, I decided to dissect the 3-2 count data by concentrating on the two extremes by which a batter can get a 3-2 count, based on the type of first pitch. The first is getting to a 3-1 count before strike 2 and the other is beginning 0-2. If we distinguish the type of strike one, then there are 7 different situations here:

3-1
BBBKK
SBBBK
CBBBK
FBBBK

0-2
SKBBB
CKBBB
FKBBB

where “K” refers to a strike of any type after the first pitch. The differences in outcomes for these 7 are shown in Table 11.

Table 11. Full Count Batting Performance as result of 3-1 or 0-2 Intermediate Counts

Intermediate 3-1	BA	OA	SA	PA%	LW500
BBBKK	.232	.473	.368	1.21	30.0
SBBBK	.205	.459	.338	0.11	24.0
CBBBK	.227	.475	.357	0.53	29.4
FBBBK	.232	.473	.392	0.20	32.6
	.229	.473	.366	2.04	29.8

Intermediate 0-2	BA	OA	SA	PA%	LW500
SKBBB	.199	.439	.334	0.24	19.0
CKBBB	.225	.463	.363	0.98	27.2
FKBBB	.240	.471	.395	0.36	32.3
	.224	.461	.366	1.58	27.1

Once again the swinging strike one is clearly the most damaging. Note the very different frequencies. A batter who takes strike one is over four times as likely to get to a 3-2 count than one who swings at the first pitch. What about strikeouts and walks? Table 12 presents that information for the seven situations in Table 11, with the original measures removed:

Table 12. SO38 and BB38 as result of 3-1 or 0-2 Intermediate Counts

Intermediate 3-1	SO38	BB38
BBBKK	7.6	11.9
SBBBK	10.0	12.1
CBBBK	7.5	12.1
FBBBK	7.8	11.9
	7.8	12.0

Intermediate 0-2	SO38	BB38
SKBBB	10.6	11.4
CKBBB	8.1	11.6
FKBBB	8.3	11.5
	8.5	11.6

The swinging strike one continues to stand out. I therefore conclude that there is a dominance by pitchers who get a swinging strike to start a plate appearance and that carries all the way through, even to the last pitch of 3-2 counts.

There are several aspects to pitch sequences left to investigate, but we are limited for time so I will mention two that I explored briefly. The first is the concern that “regular” batters may not show the same pattern found for all batter, including bench players and pitchers as well. I separated out the performances of “regular” batters and “regular” pitchers (250 plate appearances for batters and either 81 innings or 81 games for pitchers). The numbers for those players did not show significant differences from what I presented here.

The other topic I explored briefly is the nature of the batter. I thought that free swinging power hitters might show different patterns, such as different tendencies to swing at the first pitch. In fact I found no differences on this basis either. I did not separate pitchers into "power" and "finesse", but I am doubtful that it would matter either.

Conclusions

- A first pitch strike is important for a pitcher, just as Ray Miller said, but getting strike 2 is much more important, and not just for strikeouts
- But the first pitch shouldn't be too good, since batters do very well when putting the 0-0 pitch into play.
- The type of first pitch strike is very important, with a first pitch swing and miss leading to much better outcomes for the pitcher.
- All counts that get to 3 balls are favorable to the batter.
- Long and very short pitch strings are both very favorable to the batter.

Suggestions for future work

- The advent of Questec raises the fascinating possibility of looking at the coordinates of pitches that batters miss. The damaging effects of swinging strike one might just be overall bad strike judgment.
- Situational differences could be very important: inning, home vs road, left vs right, score of game, etc. It is common to hear about "adjustments" by both batters and pitchers in response to such factors.