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Paper Title: An Analysis of the Relationship between Pressure and Performance in Major
League Baseball Players

If you were to scrutinize Alex Rodriguez's statistics during the 2006 season, you would probably be very impressed, especially if you compared his numbers to those of other players in the league. Rodriguez batted .290, hit 36 home runs, drove in 121 RBI, and had one of the highest slugging percentages in the league. However, if you were to compare those statistics with his performance in the years prior to and following the 2006 season, you might be less impressed, as Rodriguez did noticeably better in those years, putting up numbers that would give many people reason to label him the best player of his time.

However, if you are a Yankee fan (as I am), and watched many of the Yankee games during the 2006 season, you would clearly get the impression that Alex Rodriguez was not playing well. Certainly it would seem that he was not living up the huge expectations that Yankee fans had for him. Rodriguez seemed only to perform well in unimportant situations and rarely hit well in important games. Often, Alex Rodriguez would find himself up in the bottom of the ninth at Yankee Stadium with runners on base, 2 outs, and a chance to win or tie the game for the Yankees. The crowd would stand up and urge him on, only to see him fail time after time in these crucial situations. Yankee fans were quick to label Rodriguez as a "choker". He simply did not appear to be able to deal with all the pressure heaped onto him. Fans were quick to compare him to his fellow teammate and Yankee favorite, Derek Jeter, a player who was known to make incredible plays and get timely hits when the Yankees needed him most. The fans often booed Rodriguez during the course of the season, and Rodriguez struggled to succeed. When

the playoffs came, Rodriguez still could not perform well under pressure and batted a measly .061 with only one hit.

However, even after I watched the entire season unfold and witnessed Alex's so-called poor performance, I would look back on his statistics for the season and wonder, "How was this considered a bad season, and why did he always seem to fail in important situations?" I quickly realized the answers, as they were rather self-explanatory. Rodriguez failed considerably more often in these situations because everybody was counting on him to succeed. In other words, there was too much pressure on him. At the same time, because I frequently watched him fail in those vital situations, I assumed that he was failing in other situations, which simply was not the case. Even though, at that point, I had a feeling that pressure was the cause of Rodriguez's failures, I still did not really know why such a thing would happen. How could somebody perform so well in unimportant game-situations and so poorly in the important ones? I was intrigued and was determined to find out.

At my high school, I participated in an independent study program, which focused on behavioral science research. During the beginning of my Junior year, I decided to start a project analyzing baseball statistics in order to determine if there was any relationship between the quality of the players' performance and the amount of pressure in each situation.

I began researching past studies that looked at professional athletes and their performance in high-pressured situations. Not surprisingly, I learned that generally, in situations of extremely high pressure, athletes perform poorly. I found that baseball players performed worse in many different situations of high pressure. Players

performed worse than average with two outs, with runners on base, during the late innings of games, or when the game was close (Heaton & Sigall, 1989).

More interestingly I read several papers that detailed a strange phenomenon. These papers analyzed the home team's performance during Game 7 (the last game) of the World Series, the Stanley Cup finals, and the NBA finals. This seventh game was the deciding game in all of these championship series since the series are out of seven games. In all three of these sports, the home team normally has an advantage over their opponent during the course of the regular-season (Baumeister & Steinhilber, 1984). Consequently, in all three sports, the home team won significantly more than half the time. However, during Game 7 of the championship series, the home team lost their advantage. During these games, the home team actually won disturbingly less often, in baseball only 39% of the time (Baumeister & Steinhilber, 1984). Furthermore, I read that the New York Yankees, the Montreal Canadiens, and the Boston Celtics, which are the teams who have won the most championships in their respective sports, perform even worse than do other teams at home during Game 7 of the championship series. The fans of these extremely successful teams expect victory of their team, and it may be that these incredibly high expectations place even greater pressure on the players, further decreasing their performance (Benjfield & Liddel, 1989). These results all suggest that pressure and anxiety can have a large impact on the outcome of professional sporting events.

While reading past papers was a great help to me, I found my most useful piece of information during my psychology class in school. We were learning about the Yerkes-Dodson law, which discussed how people were affected by pressure. Yerkes and Dodson had found that there was a relationship between arousal and the performance of any task.

When arousal was very low, people did not have any motivation to perform their task well, and, as a result, performed poorly. As arousal increased and became more moderate, performance steadily increased, but when arousal became too high, performance decreased again. From this relationship, I was able to derive my hypothesis. I predicted that professional baseball batters would perform best in situations of moderate pressure and worse in situations of extremely high or low pressure.

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Figure 1 (Yerkes & Dodson, 1908). Yerkes and Dodson model
for performance in different situations of arousal

While I was immediately intrigued with my project choice, I also immediately ran into problems. I was unsure of how I would measure the amount of pressure that players felt. I knew I would have to create some sort of statistic that would approximate the amount of pressure that players felt in each individual situation of each game.

In the end, after a long period of deliberating, I finally decided to create two formulas, which were used to measure pressure. One of these measures, Game Importance, measured pressure based on how important each game was to the players, while my other measure, In-game Pressure, measured how much pressure players felt during each individual game situation. I created a formula that approximated how

important each game was to the players. I chose only to include regular-season games and not to include playoff games. My Game Importance measure was based on how many games behind or ahead a team was from being in the playoffs and how many games were left in the season. I assumed that the most important game possible would be the last game in the season where a team was tied for a playoff spot. The formula that I created was as follows:

Game Importance =
(Number of games behind/ahead of 2nd place team +1) x (Number of games left in the season)

According to my formula, the lower the Game Importance number was, the more important a game would be. However, my formula was far from perfect. I knew very well that there were many other factors that might affect how much pressure players felt. I knew that there was more pressure when teams played their rivals, in games with large attendances, and in games between the first and second place teams. Some of these statistics, like attendance, were unavailable to me at the time. Additionally, I was not able to create a neat formula that included all of these different factors without my formula getting to complex, so I decided to keep the formula relatively simple, but still accurate.

The other measure of pressure I created, In-game Pressure, measured how much pressure there was in each individual situation in a game. In-game Pressure was based on how many outs there were, what inning it was, what the score differential was, and how many runners were on base. Based on the results of past studies, I assumed that there would be more pressure when there were two outs, when it was a close game, during the later innings of the game, and when there were more runners on base. I did not include

situations during extra innings, since my formula did not allow it. The formula for In-game Pressure was as follows:

In-game Pressure = (3-Number of Outs) x (Score Differential +1) x (10-Inning) x (4-Runners on Base)

Like for Game Importance, the lower the number was, the higher the pressure was in each situation.

I measured the performance of the batters in my study using two standard baseball statistics, RBIs and slugging percentage. I then ran curvilinear regressions between each pressure variable and each performance variable. I found that, in general, players performed better in moderate pressure and worse in high- or low-pressure situations.

My study confirmed that the Yerkes-Dodson law applied to professional baseball players. When all the players were looked at together, they performed best in situations of moderate pressure. However, I did not look at the individual performance of players. I was still confused as to why Alex Rodriguez does so much worse than Derek Jeter does under pressure, but overall has significantly better statistics. I do now have an idea as to why that happens. It may be that while both Derek Jeter do worse than average in low- and high-pressure situations, it may be that their respective tolerances for pressure are different. It might be that Derek Jeter's arousal curve is simply shifted further right than is Rodriguez's. Jeter might perform best in the situations that are moderate pressure for him, but for Rodriguez they are situations of high pressure. It could be that the optimal pressure amount is different for each player. An average situation in an unimportant game might be extremely unimportant (and therefore a situation of low-pressure) for a veteran, but the same situation could be a situation of extremely high pressure for a player that is playing in his first Major League game.

My project certainly did not answer all of my initial questions on pressure and the performance of professional baseball players, yet it answered some. For me, my paper is not the end of my research in this topic. I hope that I can find more complete answers to my questions in the near future, and I definitely hope to continue my research next year at Cornell University.