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Mind games:

Does using a Mental Skills coach improve

the performance of professional baseball players?

Chris Hayes

A Thesis in the Field of Psychology

for the Degree of Master of Liberal Arts in Extension Studies

Harvard University

Extension School

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Abstract

This study collected an unprecedented dataset from 194 current and former professional baseball players to investigate how professional baseball players who work with a Mental Skills coach differ from players who do not. Specifically, the study found players who worked with a Mental Skills coach played statistically significantly longer (2.3 years longer, on average) and reached statistically significantly higher levels of professional baseball (1.25 levels higher, on average) than players who did not work with a Mental Skills coach, even after correcting for selection biases. Additionally, players who worked with a Mental Skills coach self-reported statistically significantly more positive responses to statements like “I got everything out of my skillset” and showing significantly more positive responses to the question “How did your off-the-field life (relationships and/or habits/activities) affect your on-field performance?” While the hypotheses of improved statistical performance, as judged by Earned Run Average and Batting Average, as well as by the frequency and duration of slumps and hot streaks did not evidence statistical significance, a significant flaw in the data collection process caused very poor performance to be encoded as performance with a Mental Skills coach since poor performances often led to a player hiring a Mental Skills coach and this very poor performance often occur immediately before hiring the coach. Numerous trends in the data show optimism for a future study with improved data collection processes and improved research design to examine performance benefits of Mental Skills coaches.

Dedication

I dedicate this thesis to my wife and children for their amazing support of this incredible journey pursuing my dreams.

Acknowledgements

I would to thank my thesis advisor Dr. Jonathan Jenkins, Psy.D and my research advisor Dr. Dante Spetter, Ph.D for their constant encouragement and help. I'd also like to thank the members of the Professional Baseball Players Association for their overwhelming support and willingness to help gather a frank and comprehensive dataset with hopes of furthering the field of sports psychology.

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Chapter I

Introduction

Understanding what makes one professional baseball player perform better than another is a complex task. This research aims to determine whether Mental Skills coaches have an impact on the performance of professional baseball players. Traditionally, baseball instruction and player development has focused on the development of physical skills and abilities, in addition to the prevention of physical injury. Recently, efforts have been made by both players and entire organizations to improve the mental training of athletes, although there is limited research on the efficacy of Mental Skills training.

The present study examines within-subject effects (before and after using a Mental Skills coach) as well as between-subject effects (coaching and non-coaching groups) to explore the effect a Mental Skills coach has on a professional baseball player's performance. It is hypothesized that (1) professional baseball players who worked with a Mental Skills coach will perform better, on average, than professional baseball players who did not work with a Mental Skills coach and that (2) professional baseball players who begin working with a Mental Skills coach will perform better than they did before they worked with the coach. Additionally, it is hypothesized that (3) players who work with a Mental Skills coach will play longer and (4) reach a higher level of play, on average, than players who do not work with a Mental Skills coach. Lastly, it's hypothesized that (5) players who work or worked with a Mental Skills coach will self-report more favorably on a number of measures reflecting back on their careers.

Currently, there are no studies comparing the statistical performance of coaching and non-coaching groups of professional athletes. It can be assumed that at the highest levels of performers (ie. professional athletes), the level of physical skills is so close to its theoretical ceiling that differences in performance based on Mental Skills will be more informant as well as more valuable.

The field of research on various types of Mental Skills and sports psychology coaching in different arenas such as executive coaching in corporate organizational settings or sports psychologists working with golfers collectively points towards the efficacy of coaching.

Relatively few studies have looked at sports psychology within amateur sports and even fewer have examined applications within professional sports. Due to these limitations, the research is primarily based upon knowledge from (1) current research examining the efficacy of coaching in other fields such as executive coaching, (2) coaching-related research in other sports fields or non-professional levels of play, and (3) baseball-related research that studies topics related to coaching, for example, a study looking at life skills impacted by coaching, and how these life skills improve baseball performance (Hardcastle, Tye, Glassey, & Hagger, 2015). To bring this body of research together, one study (Gordon, 2007) will demonstrate the link between coaching in other fields and coaching in sports, while additional research will demonstrate the benefits of Mental Skills training in other sports (Thelwell & Greenlees, 2001; Thelwell & Maynard, 2003).

Coaching

While it is important to begin with an operating definition of "coaching," it is also important to note the inexactness of any definition of the word. Grant et al. (2003) defined coaching as "a collaborative solution-focused, result-orientated and systematic process in which the coach facilitates the enhancement of life experience and goal attainment in the personal and/or professional life of normal, nonclinical clients." However, not all researchers have applied this specific definition and thus there must be caution when drawing specific conclusions from one study and applying these conclusions to another situation. Importantly, it can appear as though there is not a clear separation between coaching, collaborating, and other performance-based interventions whether in the world of sports or in other applications, leading to inconsistency within the literature.

Meta-analytic research supports a consensus that 'coaching' is effective in improving the performance and skills of the subject. Taken collectively, the research supports a variety of coaching styles can demonstrate positive outcomes (Bühlmayer, Birrer, Röthlin, Faude, & Donath, 2017; Theeboom, Beersma, & Vianen, 2014). For the purpose of this research, forms of sports psychology, Mental Skills training, and executive coaching are referred to collectively as 'coaching'.

Executive Coaching

There have been numerous studies that have shown positive effects using various coaching techniques in the business world, often referred to as "executive coaching." As

the most-researched area of coaching, executive coaching research suggests that coaching is associated with an executive's personal well-being, work attitudes, and self-regulation, as well as improved goal directed behavior in the work setting (Jones, Woods, & Guillaume, 2016; Theeboom, Beersma, & Vianen, 2014). Theeboom et al. (2014) performed a meta-analysis of coaching research looking specifically at five outcome categories: performance/skills, well-being, coping, work attitudes, and goal-directed self-regulation. Using Hedges *g* to calculate the effect size of scores in these five categories, 18 studies were examined (Hedges, 1981). Overall, as an aggregation of all studies and outcomes, the authors found coaching had a significant positive effect ($g = 0.66$, $p = 0.000$). Furthermore, coaching evidenced positive effects on all outcome categories: performance and skills ($g = 0.60$, $p < 0.05$), well-being ($g = 0.46$, $p < 0.001$), coping ($g = 0.43$, $p < 0.001$), work attitudes ($g = 0.54$, $p < 0.001$), and goal-directed self-regulation ($g = 0.74$, $p < 0.001$).

The Theeboom et al. (2014) meta analyses demonstrated overall significant findings that executive coaching benefitted the executive, however the two categories with the highest variability between studies' results were in "performance skills" as well as "goal-directed self-regulation." Of the five categories examined by Theeboom et al, these two categories would most likely translate to the realm of sports, so despite the overall significant findings, one should proceed with caution when applying the findings of executive coaching to the field of sports (Theeboom et al, 2014). Additionally, Theeboom et al attempted to categorize published research and consolidate findings, however in order to accomplish this goal, the authors had to first determine categories

and then consolidate results from research conducted for a variety of reasons with varied hypotheses. The categorization the authors performed was based on the collective categories of the data in their study rather than preconceived delineations, which introduces both confirmation and research bias. While this technique was perhaps necessary for their analyses to be so comprehensive, it is important to note this limitation.

Jones et al (2016) aimed to improve on the Theeboom et al study by categorized coaching outcomes based on existing criterion frameworks. To accomplish this distinction, the study used the following measures: affective outcomes (self-efficacy, well-being, satisfaction), cognitive outcomes (problem-solving), skill-based outcomes (leadership/technical skills, competencies), and results (individual/team/organizational performance) (Jones, Woods, & Guillaume, 2016). With these pre-determined criterions in place, overall, Jones et al found coaching significantly improved all outcome criteria. Using a corrected population sample-weighted mean effect size (d̓), the authors found significant improvements overall (d̓ = 0.36), affective outcomes (d̓ = 0.51), skill-based outcomes (d̓ = 0.28), and individual-level results outcomes (d̓ = 1.24), providing even stronger evidence that executive coaching has very real benefits (Jones, Woods, & Guillaume, 2016). To examine specific results of executive coaching, Grant et al (2009) set up a randomized, controlled trial of executive coaching at a large corporation in Australia, with more than a $1 billion USD per year budget. Executives and senior managers were randomly assigned to a controlled waitlist design and data was collected at three intervals: before treatment, Group 1 treatment/Group 2 waitlisted, and Group 2

treatment. The leadership program was standardized and the quantitative measures taken were: goal attainment, resilience, depression/anxiety/stress, and workplace well-being.

While depression, anxiety, and stress did not show any significant differences between intervals, the other measures all showed a significant increase from the treatment: goal attainment ($F = 26.26$, $p < 0.001$), resilience ($F = 6.75$, $p < 0.05$), and workplace well-being ($F = 3.39$, $p < 0.05$).

Numerous other studies using self-reporting have consistently shown the positive effects of coaching. Kombarakaran et al (2008) studied 114 executives over a 6-month period and demonstrated that goal-setting measures were reportedly between 76-88% improved after 12 coaching sessions. Additionally, 78% of the executives perceived themselves as more productive and 75% were more satisfied with their work environment (Kombarakaran, Yang, Baker, & Fernandes, 2008) after the coaching process.

Studies have shown executive coaching to be successful in a broad range of organizations from non-profits (Fischer & Beimers, 2009), Fortune 500 tech companies (Moen & Skaalvik, 2009), to multi-billion-dollar international companies (Williams & Lowman, 2018).

Parallels between corporate performance improvements after executive coaching and sports performance due to Mental Skills coaching suggest that findings in executive coaching research (ie. goal-setting and goal attainment, confidence, productivity, performance) are directly relevant to improved sports performance (Cheshin, Heerdink, Kossakowski, & Van Kleef, 2016; George, 1994; Lochbaum & Gottardy, 2015). In other words, the benefits that executives receive from executive coaching are building blocks

for possible success in sports if these same skills are used by athletes. The similarities in job requirements, characteristics that lead to success, and lifestyle of executives and athletes has not only led to corporate executives being referred to as "corporate athletes," but has also led to the suggestion that sports and businesses take a collaborative research approach regarding coaching (Gordon, 2007).

Non-Baseball Sports 'Coaching' Research

Coaching has proven to be an effective tool for improving performance in sports outside of baseball as well. Golf is one sport that, perhaps due to its notoriety for being a "mental" sport, that has seen a decent amount of research regarding coaching.

Bandura's (1977) Self-Efficacy theory posits that an individual's own evaluation of his/her skill is a determiner of that person's performance specific tasks that require use of that skill. More than perception of one's skill, Self-Efficacy theory suggests one's judgment of their skills is as important (Bandura, 1986).

A 2009 study of 41 professional golfers was conducted at an official competition. The day before competition began, players were administered a questionnaire where they ranked their own psychological characteristics. After the competition was completed, it was found that players who had performed better in the tournament (i.e. made 'the cut') had scored higher in the pre-tournament tests overall ($F = 2.54$, $p < 0.05$) and for characteristics like performance-approach goals ($F = 4.42$, $p < 0.05$), attentional control ($F = 5.26$, $p < 0.05$), and emotional control ($F = 4.48$, $p < 0.05$) (Bois, Sarrazin, Southon,

& Boiché, 2009). These results suggest that players' mindset is closely related to success under high-stress playing conditions.

Two studies by the same author (R.C. Thelwell & Maynard, 2003; R. C. Thelwell & Greenlees, 2001) perhaps most closely support the foundation for Mental Skills training as a means to improved performance in sports. A Mental Skills training regimen was applied to both cricket and triathlon performers. Both studies provided the athletes with a Mental Skills Training Package, which essentially was a workbook with four exercises. The exercises were administered with a coach; however the training was dictated entirely by the workbook. The workbook consisted of four parts: goal-setting, relaxation, imagery, and self-talk. In the Gymnasium Triathlon experiment, all five participants showed decreased times immediately following the treatment. Treatments were administered at different points for each participant to avoid any time or practice confounds. Additionally, a measure of perceived desire to "win" the trial and receive a reward for a successful performance ensured each round that the participants had reported to have the same desire to achieve their best time. The authors did not report any statistical analysis for their findings, perhaps because of such a small sample size.

While Thelwell's (2001) Gymnasium Triathlon study shows significant and convincing findings, it is also important to note the small sample size and the risk of demand characteristics (and placebo effects) as the participants were clearly aware of when the treatment was administered.

Thelwell's (2003) Cricket study specifically focused on repeatable good performance, which is a concept developed by Thelwell (2002) to understand what

psychological underpinnings lead to consistently good performance in sports like cricket (or baseball) where consistency of performance over a very long game/season is especially important. The Cricket study showed that 'coaching,' in the form of Mental Skills training, significantly improved the performance consistency of those in the treatment group by way of standardized standard deviations in a 2x2 (group x time) MANCOVA, which demonstrated significant interaction between group and time ($F = 3.61$, $p < 0.05$, effect size $\eta^2 = 0.22$). Performance improvement also showed significant group by time interaction ($F = 7.84$, $p < 0.05$, effect size $\eta^2 = 0.37$) in a 2x2 (group x time) MANCOVA of the means of subjective scores (coach's ratings) and means of standardized scores (statistics from performance in contests).

Furthermore in the subsequent seasons, four participants participated in a single-case data analysis wherein the participants' performances were compared against previous seasons. In three of the four participants, their second-season performance was improved slightly, on average, and the improvement came largely from more consistent results. These results support the current research hypothesis of fewer slumps and overall better performance for baseball players across a given season when using Mental Skills training. Though the effects are small, and the sample size of this follow-up study was only N=4, the results still should be viewed as promising (Thelwell & Maynard, 2003).

Research in Baseball

While the research into 'coaching' in relation to baseball is limited, there is related research that demonstrates the promising benefits coaching could have for

baseball players. The idea of sports psychology as it relates to baseball players began as early as the 1920s, with experiments to test reaction time and Mental Skills of baseball players, specifically Babe Ruth (Fuchs, 1998).

More recently, as sports psychology has evolved, research into emotions, mental state, and skills (actual and perceived) of an athlete and how that pertains to —and drives —his success has been executed. A 1994 study looked at 53 college and high school baseball players and determined through a self-report questionnaire administered for 9 consecutive days that baseball batters' self-efficacy was predictive of their hitting performance ($F = 14.63$, $p < 0.001$) such that higher levels of self-efficacy lead to more success as a batter (George, 1994).

Another study focused more directly on "life skills" development tools, such as confidence and goal-setting. Researchers assessed 54 high-performance athletes (aged 13-18, playing a variety of sports, including baseball, n=8) and put them through a coaching program consisting of focus groups and one-to-one coaching and afterwards surveyed the participants asking if their perceived skills had changed. The athletes, on average, showed a significant increase in perceived skills such as confidence and goal-setting after the coaching intervention (Hardcastle, Tye, Glassey, & Hagger, 2015). However, this research relied on qualitative aggregation of the players self-reports and did use quantitative analysis to reach the conclusions. While this helps shape the landscape of the efficacy of coaching interventions, it does not add to the empirically supported theoretical basis.

Two known studies have looked at professional baseball players (Cheshin, Heerdink, Kossakowski, & Van Kleef, 2016; Smith & Christensen, 1995). One of these was an innovative study where volunteers examine video clips of Major League Baseball games (from the 2011 and 2012 World Series) using short 1.5-3s clips of a pitcher pitching the ball. All clips showed the pitcher's face clearly prior to him throwing. 151 participants watched the clips and rated the emotional expression on players' and then the participants predicted whether the pitcher would throw a hard or soft pitch, and what the outcome (ball, strike, or hit) of the pitch would be. It was found that players who were perceived to be showing signs of anger were predicted to throw faster, more difficult pitches but with less accuracy than pitchers rated as showing happier emotions. While there are issues with this research, it is interesting to note the relationship between emotional expression and pitching performance in sport (Cheshin, Heerdink, Kossakowski, & Van Kleef, 2016).

Lastly, Smith and Christensen (1995) performed novel research by collecting Athletic Coping Skills Inventory (ASCI-28) scores of 104 minor league professional baseball players prior to their season. The study collected scores as self-reported by the players themselves, and as reported about those same players by their coaches. This allowed the researchers to get both a self-report and an external report to test validity. In the end, the researchers found that Coach-ability ($r = 0.52$), Coping with Adversity ($r = 0.47$), and Confidence ($r = 0.46$) were most closely correlated with future success 1, 2, and 3 years later. Also of note, prior to the study, the coaches also rated the players for their physical abilities. Interestingly there was no significant correlation between the

physical ability scores and the ACSI-28 scores indicating the staff's ratings of psychological abilities were not tied to the player's actual physical ability. Perhaps even more interesting is that the psychological ratings accounted for as much performance variance (20%) in the player's batting average as did their physical abilities (Smith & Christensen, 1995). Given the strength of psychological factors in predicting performance, it seems likely that coaching would be very helpful to baseball players.

Critiques of Current Research as a Whole

While the research on coaching points to a consensus of coaching being effective in promoting benefits in performance, as well as in the skills that would lead to performance, there are also reasons to be skeptical of the current research.

One significant reason for skepticism of these results is that many of these studies were performed by practitioners who are not clinicians and have not been trained in proper research methodology. Thus, the validity of findings should be brought into question and any theoretical foundation from which to build upon would need more solid research before it could be cemented into place (Grant, 2013).

Another reason for caution and concern about research related to executive coaching is that often multi-source feedback (i.e. performance reports, peer reviews/ feedback, etc.) are a pre- and post-measure to determine if coaching has been effective. However, it has been shown that merely receiving multi-source feedback itself increases performance over time (Smither et al, 2003), independent of — and calling into question the efficacy of — the coaching treatment (Smither et al, 2005).

Study Aim & Hypotheses

This research will aim to answer the question "How does a professional baseball player who works with a Mental Skills coach differ in his performance from a player who does not work with a coach?" There is an expanding field of research on different types of Mental Skills and sports psychology coaching in different fields (executive coaching in corporate organizational settings, sports psychologists in various sports — often golf), that collectively points to the efficacy of coaching. It is hypothesized players who work with Mental Skills coaches — referred to as members of the Mental Skills group — will perform better than those who do not — Non-Mental Skills players. This research will be novel in that this exact hypothesis has never been tested on professional baseball players, yet there is an ever-growing collection of studies in environments similar to professional baseball that call for this research question to be asked, that supports the aforementioned hypothesis, and suggests that Mental Skills coaching within professional baseball may be an effective tool for developing players to maximize their potential.

Aim 1

This study aims to examine the difference between the statistical performance of a player who works with a Mental Skills coach and a player who does not work with a coach. Statistical performance will be measured by Batting Average (AVG) for hitters and Earned Run Average (ERA) for pitchers. Additionally the frequency and duration of hot streaks and slumps will be calculated and compared. It is hypothesized that players who

used a Mental Skills coach will perform statistically better, will have fewer and shorter slumps, and more frequent and longer streaks than players who do not use a Mental Skills coach.

Aim 2

This study aims to examine the difference in performance of players before and after they begin working with a Mental Skills coach. Again, using AVG and ERA, a within-group measure of the Mental Skills players will be explored to evaluate the difference between the overall statistical performance of a player before and after working with a Mental Skills coach. A player's streaks and slumps frequency and duration will also be compared during and before/after working with a Mental Skills coach. It is hypothesized that while players are working with a Mental Skills coach, they will perform better and will have fewer and shorter slumps, and more frequent and longer streaks than when they are not working with a Mental Skills coach.

Aim 3

This study aims to examine the difference between the career lengths of players based on whether or not he works with a Mental Skills coach. It is hypothesized that players who use a Mental Skills coach will have longer careers. Additionally, to remove selection bias, it is hypothesized that players who start using a Mental Skills coach during their career will go on to have a longer career on average than players who don't choose to use a Mental Skills coach at that point in their career.

Aim 4

This study aims to examine the difference between the highest playing level achieved by a player based on whether or not he works with a Mental Skills coach. It is hypothesized players who use a Mental Skills coach will have, on average, reached a higher playing level (ie. Single-A, Double-A, Triple-A, MLB). Additionally, to remove selection bias, it is hypothesized that players who start using a Mental Skills coach during their career will experience more promotions to higher levels on average than players who don't choose to use a Mental Skills coach at that level in their career.

Aim 5

This study aims to examine the difference between self-reported factors about a player's career and life after their career based on whether or not the player worked with a Mental Skills coach while they played. It is hypothesized that working with a Mental Skills coach will improve self-reported scores on questions like "I got everything out of my skillset," "How would you rate your on-field performance overall?" and "When my playing days ended, I was in a good position to succeed professionally."

Significance of Study

Overall, there is a substantial body of work pointing towards the efficacy of coaching. Despite some limitations within this body of literature, overall there is a preponderance of positive significant results that supports that coaching would be beneficial for the performance of professional baseball players. The struggles and

difficulties experienced by professional baseball players are more physical in nature than those experienced by high-performing executives, however it could be argued that the mental and psychological stresses have a lot in common. Additionally, research exists linking mental and psychological outlook to physical performance, which further strengthens the link between the significant research conducted within executive coaching and the realm of professional baseball (Gordon, 2007).

While there is less research in baseball specifically, and even less within the professional ranks of baseball, it would stand to reason that the overwhelming significant positive findings of coaching as a means to improve baseball performance would apply at higher-performance levels. In fact, some of the research indicates that these benefits are stronger at the higher levels of performance (Hardcastle, Tye, Glassey, & Hagger, 2015). Additionally, many sports have been studied and have showed a significant performance boost from coaching.

However, to date, there is no large-scale study of baseball players assessing how those athletes who work with a Mental Skills/psychological coach differ from those players who do not. This research aims to build upon current literature and broaden the acceptance of Mental Skills and sports psychology research into the realm of professional baseball.

Chapter II

Method

The study was conducted using an online Qualtrics survey. The target sample was 120 participants, with at least 30 participants in the Mental Skills coach group. Additional publicly-available data associated with each participant was collected from baseball-reference.com to assess varying measures of a participants performance as a baseball player. Participants were recruited through a members-only online forum for the Professional Baseball Players Association (PBPA).

The participants for this study were exclusively current or former professional baseball players. A professional baseball player was defined as a player who has played at least one game for a Major League Baseball (MLB) team or for a Minor League affiliate of a MLB team. Participants were required to include their name and the team(s) they played for, and this data was referenced and verified using baseball-reference.com, mlb.com, or milb.com to determine the participant's qualification in the study.

Participants will be recruited using the private, members-only online forum for the PBPA, which was founded and run by the author of this study. A post in the forum recruited players by asking participants to click a link to begin a survey. Compensation for completing the survey was a $20 coupon code to a merchandise store for the group. The compensation was advertised in the post.

Participants

A total of 194 participants completed the survey, 135 of whom met the inclusion criteria. Fifty-two participants were excluded from the sample for one of three reasons: (1) they played less than two full seasons or (2) as a pitcher, the players had fewer than 100 innings pitched or (3) as a hitter, they had fewer than 750 at bats in the Major or Minor Leagues of baseball. Seven participants gave false names and/or details about their playing career, which did not allow for their statistics to be found on baseball-reference.com.

Of the 135 qualifying participants, three participants (2.2%) were currently still playing professionally at the completion of the study while the average participant had been retired for 13 years. The average career length of the participants was 6.02 years. Thirty-six (26.7%) participants used a Mental Skills coach during their professional career. Twelve (8.9%) participants played in the Major Leagues, 65 (48.1%) played in Double-A or higher and 70 (51.9%) played no higher than Single-A (Table 3).

All thirty Major League Baseball organizations were represented in the sample, with at least six participants having played for every organization (Figure 1). On average, participants played for 2.25 organizations during their careers.

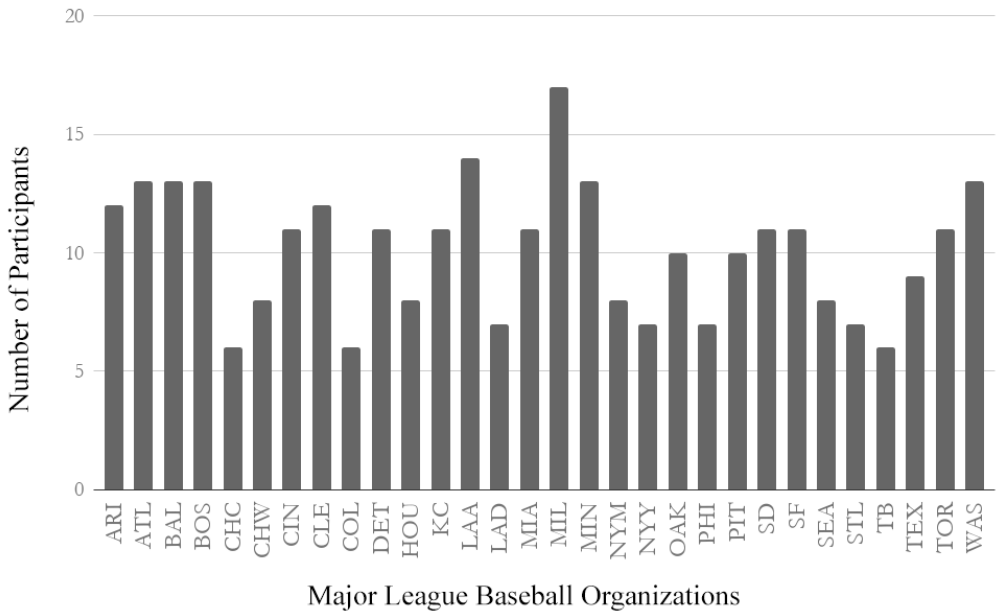


Figure 1: Distribution of participants across all thirty Major League Baseball organizations.

Outliers

Seven participants were excluded from the study because their performance metrics were more than 2 standard deviations from the mean (Figures 2 & 3).

Materials

A survey administered via Qualtrics was accessed by the participants on a computer or mobile device at their leisure. The survey was advertised on the PBPA's online forum, and participants were able to click the link and directly begin the survey.

Measures

Mental Skills Coach Measures

Survey questions asked players if and when they started using a Mental Skills coach during their career. A binary variable Mental Skills was coded as 1 for players who selected that they had worked with a Mental Skills coach during their professional career and 0 for players who did not. Players with a Mental Skills value of 1 are referred to as members of the Mental Skills group. If a participant worked with a Mental Skills coach, they were asked to classify the type of coach (sports psychologist, therapist, Mental Skills coach, hypnotist, mindfulness/zen master, or other). This classification allowed for multiple selections and was encoded as binary variables for each coach type.

Statistical Performance Measure

Pitchers and hitters have different measures for their performance. Pitchers are typically judged by their Earned Run Average (ERA). ERA indicates the number of runs, on average, per nine innings that a pitcher would surrender to the opposing team, assuming his defense made no errors. As a reference point, in 2018, the average ERA of all MLB pitchers was 4.14. Typically an ERA under 3.00 (meaning a pitcher would surrender 3 runs per full 9-inning game, assuming a flawless defense) is considered very good. An ERA above 5 would be considered poor. ERA is calculated by multiplying the number of earned runs a pitcher gives up by 9 and dividing by the number of innings he

pitched. A lower ERA indicates fewer runs surrendered and therefore better performance for a pitcher.

Hitters are typically judged by their batting average (AVG). AVG indicates the odds of a hitter getting a base hit in a given at bat. In 2018, the average AVG of all MLB hitters was .248. Typically an AVG higher than .285 (meaning a hitter gets a hit 28.5% of the time) is considered very good and an AVG under .230 is considered poor. A higher AVG indicates a higher likelihood of a hitter getting a hit and therefor better performance.

Since ERA and AVG are different measures on differing scales, in order to allow for comparisons across player type (hitters and pitchers) the data was normalized so the performance measures of hitters and pitchers (AVG and ERA, respectively) became one standardized metric. This metric, labeled as Performance Metric, measured the number of standard deviations above the sample's mean for an individual's ERA or AVG. For example, a Performance Metric of 1.0 for a pitcher signified the pitcher had an ERA 1.0 standard deviation lower (since lower ERA is better) than the sample mean ERA for pitchers. A Performance Metric of 1.0 for a hitter signified the hitter had an AVG 1.0 standard deviation higher (since higher ERA is better) than the sample mean AVG for hitters. A Performance Metric of -1.0 would indicate performance 1.0 standard deviations worse than average for a pitcher or hitter, and a value of 0.0 would indicate average performance. This allowed for a normalized measure of performance that was standardized across hitters and pitchers.

Streak/Slump Measures

For the purposes of this study, a streak is defined as a 5-game period where a player's ERA or AVG (if he is a pitcher or hitter, respectively) is 33.3% better than his career average ERA or AVG. For example if a pitcher has a career ERA of 3.00 and has a 5-game stretch with an ERA under 2.00, this stretch would be considered a "streak". If the pitcher's 6th game produced results that also garnered a 5-game stretch of ERA under 2.00, then the streak is considered to continue (a new streak is not counted). This allows for a measure in streak length in addition to frequency.

Slumps are calculated similarly; as slumps are defined as a 5-game stretch with a 33.3% worse performance than average. For example, if a hitter has a career AVG of .270 and has a 5-game stretch with an AVG under .180, this would be considered a "slump." Slump length is calculated in the same fashion as streak length.

Playing Level

Professional baseball is a sport with 30 organizations. Each organization (i.e. Red Sox, Yankees, Dodgers, etc.) operates a Major League baseball team as well as several Minor League teams. All 30 organizations have Rookie, Single-A, Double-A, and Triple-A teams below the Major League team. All organizations have Single-A split into a High-A and Low-A team, and these were combined to one Single-A level for this analysis. Players in these minor leagues are employees of the organization and are vying to get promoted up the levels from Single-A to Double-A to Triple-A to the Major Leagues, for

example. One measure of career success is how high a player has played. These levels were coded as 0 = Rookie, 1 = Single-A, 2 = Double-A, 3 = Triple-A and 4 = MLB.

Self-Report Measures of Career / Post-Career Success & Satisfaction

The survey included a number of Likert scales asking participants to rate their overall experience as a professional baseball player. Questions like "Looking back on [or 'Looking over' for current players] your career, on a scale of 1 to 7, how would you rate your on-field performance overall (1-very poor —> 7-very good)?" provided information on how a player perceived his performance. These questions were used to determine if Mental Skills and Non-Mental Skills players evidenced differences in how they transitioned out of the profession. Examples of these measures can be found in Table 7.

Procedures

Study Protocol

The researcher posted an invitation to participate on the PBPA online forum requesting volunteers to fill out a quick 15-minute survey about their professional baseball career. Included in the post was a picture of merchandise with the PBPA logo available to purchase with the $20 off coupon for completing the survey. The post contained a link that, when clicked, brought the participant to a Qualtrics survey. The first page of the survey was a consent form, which was required to continue the completion of the survey.

At the completion of the survey, the participant was thanked and shown a message explaining they were to be emailed a coupon code for their $20 off within 24 hours. All participants — including non-qualifying participants — received their coupon code within 24 hours via email.

Data Collection

After the study was complete, based on the participant's name, teams played for, and years played, the player's public Baseball Reference page was found. If there were multiple players with a given name, the search results were parsed to match the teams played for and years played indicated by a participant. Once a profile was found that matched the teams and years, that profile was used to collect performance data for the participant.

The data on Baseball Reference contains year-by-year statistics for every player for their entire career. Included in the career statistics are a summary of a pitcher's earned runs surrendered and innings pitched during an entire year or a hitter's hits and at bats for an entire year, summed at the bottom for the player's career (Figure 2). This data was entered into a spreadsheet for each participant and used to calculate the player's ERA or AVG for each year they played as a professional. These values were then summed to get a career metric (ERA or AVG) for each player. Additionally, Baseball Reference contains game by game results — meaning if a player played in 150 games in a season it may have a log for all 150 data points (games) with the number of hits and at bats for each individual game (Figure 3). Where this was true, these game logs were exported into a

spreadsheet for each player and used to calculate the frequency and length of slumps and streaks. To do so, for each game in the log, the cumulative ERA or AVG of the player was calculated for the current game and the four preceding games (five total games). For example if a player had 1 hit in 3 at bats in a game, his AVG would be .333 for that day. However, if in the four prior games he cumulatively had 2 hits in 17 at bats, his AVG for the last five games (present day included) would be 3 hits in 20 at bats, or an AVG of .150.

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Year	Age	AgeDif	Tm	Lg	Lev	Aff	W	L	W-L%	ERA	RA9	G	GS	GF	CG	SHO	SV	IP	H	R	ER
2005	22	-1.7	Windy City	FRON	Ind		4	1	.800	2.41	3.29	28	0	19	0	0	9	41.0	42	15	11
2006	23	1.2	Burlington	MIDW	A	KCR	3	6	.333	2.79	3.19	45	0	28	0	0	7	67.2	69	24	21
2007	24	2.3	Burlington	MIDW	A	KCR	4	4	.500	3.10	3.49	42	0	27	0	0	11	69.2	65	27	24
2008	25	1.0	Northwest Arkansas	TL	AA	KCR	5	2	.714	1.64	1.92	40	0	32	0	0	12	65.2	49	14	12
2008	25	1.7	Surprise	AZFL	Fal		2	0	1.000	4.30	6.14	13	0	4	0	0	1	14.2	17	10	7
2009	26		2 Teams	2 Lgs	AAA-AA	KCR	4	6	.400	3.05	3.99	44	0	28	0	0	6	85.2	100	38	29
2009	26	-1.0	Omaha	PCL	AAA	KCR	1	6	.143	4.59	4.96	26	0	16	0	0	3	49.0	67	27	25
2009	26	2.0	Northwest Arkansas	TL	AA	KCR	3	0	1.000	0.98	2.70	18	0	12	0	0	3	36.2	33	11	4
2010	27	0.3	Omaha	PCL	AAA	KCR	0	0		3.95	6.59	19	0	14	0	0	2	27.1	36	20	12
2010-11	27	0.9	Caribes	VEWL	FgW		0	0		2.08	8.31	4	1	1	0	0	0	4.1	3	4	1
2010	27	-2.4	Southern Maryland	ATLL	Ind		3	0	1.000	2.17	3.81	17	1	2	0	0	1	49.2	48	21	12
2011	28	-1.5	Southern Maryland	ATLL	Ind		1	2	.333	4.07	5.18	5	5	0	0	0	0	24.1	24	14	11
2012	29		2 Teams	ATLL	Ind		3	4	.429	5.03	5.84	16	12	1	0	0	0	77.0	93	50	43
2012	29	-0.5	Bridgeport	ATLL	Ind		0	3	.000	9.15	10.45	6	4	0	0	0	0	20.2	38	24	21
2012	29	-0.5	Long Island	ATLL	Ind		3	1	.750	3.51	4.15	10	8	1	0	0	0	56.1	55	26	22
2017	34	4.7	New Britain	ATLL	Ind		0	2	.000	6.55	6.55	8	0	5	0	0	0	11.0	14	8	8
Year	**Age**	**AgeDif**	**Tm**	**Lg**	**Lev**	**Aff**	**W**	**L**	**W-L%**	**ERA**	**RA9**	**G**	**GS**	**GF**	**CG**	**SHO**	**SV**	**IP**	**H**	**R**	**ER**
Minors (5 seasons)					**Minors**		**16**	**18**	**.471**	**2.79**	**3.50**	**190**	**0**	**129**	**0**	**0**	**38**	**316.0**	**319**	**123**	**98**
Other (6 seasons)					**Other**		**13**	**9**	**.591**	**3.80**	**4.88**	**87**	**18**	**31**	**0**	**0**	**11**	**217.2**	**238**	**118**	**92**
All Levels (9 Seasons)							**29**	**27**	**.518**	**3.20**	**4.10**	**281**	**19**	**161**	**0**	**0**	**49**	**538.0**	**560**	**245**	**191**
AAA (2 seasons)					**Minors**		**1**	**6**	**.143**	**4.36**	**5.54**	**45**	**0**	**30**	**0**	**0**	**5**	**76.1**	**103**	**47**	**37**
AA (2 seasons)					**Minors**		**8**	**2**	**.800**	**1.41**	**2.20**	**58**	**0**	**44**	**0**	**0**	**15**	**102.1**	**82**	**25**	**16**
A (2 seasons)					**Minors**		**7**	**10**	**.412**	**2.95**	**3.34**	**87**	**0**	**55**	**0**	**0**	**18**	**137.1**	**134**	**51**	**45**
Ind (5 seasons)					**Other**		**11**	**9**	**.550**	**3.77**	**4.79**	**74**	**18**	**27**	**0**	**0**	**10**	**203.0**	**221**	**108**	**85**

Figure 2: Example of the publicly-available career summary data on baseball-reference.com (abbreviated slightly to fit page). Each row demonstrates a player's involvement with a team for a certain year. ERA values exist in each row, and where ERA values needed to be summed across rows, the ERA was calculated anew using the formula ER * 9 / IP. Only rows with a value in the Aff column were used for this data since those values are associated with games played for a MLB organization.

2008 Player Pitching Game Log

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Rk	Date	Lev	Tm		Opp	Inngs	Dec	IP	H	R	ER	BB	SO	HR	HBP
1	2008-05-02	AA-TL	Northwest Arkansas Naturals	@	Springfield Cardinals	7-8		1.2	1	1	1	0	4	1	0
2	2008-05-05	AA-TL	Northwest Arkansas Naturals		Tulsa Drillers	9-9	S	1.0	0	0	0	1	1	0	0
3	2008-05-08	AA-TL	Northwest Arkansas Naturals		Springfield Cardinals	6-8		3.0	0	0	0	1	1	0	0
4	2008-05-12	AA-TL	Northwest Arkansas Naturals	@	Tulsa Drillers	8-8		1.0	1	0	0	0	0	0	0
5	2008-05-15	AA-TL	Northwest Arkansas Naturals	@	Tulsa Drillers	11-12	W	2.0	2	0	0	1	1	0	0
6	2008-05-17	AA-TL	Northwest Arkansas Naturals	@	Arkansas Travelers	8-8		0.1	0	0	0	0	0	0	0
7	2008-05-19	AA-TL	Northwest Arkansas Naturals	@	Arkansas Travelers	11-13	L	2.2	2	1	1	3	1	0	0
8	2008-05-22	AA-TL	Northwest Arkansas Naturals		Midland RockHounds	8-9	S	1.1	2	1	1	0	1	0	0
9	2008-05-24	AA-TL	Northwest Arkansas Naturals		Frisco RoughRiders	8-9		1.1	2	0	0	0	1	0	0
10	2008-05-26	AA-TL	Northwest Arkansas Naturals		Frisco RoughRiders	9-9	S	1.0	1	0	0	0	2	0	0
11	2008-05-30	AA-TL	Northwest Arkansas Naturals	@	Midland RockHounds	7-9	S	3.0	5	2	2	0	1	1	0
12	2008-06-05	AA-TL	Northwest Arkansas Naturals		Arkansas Travelers	9-9		1.0	1	0	0	0	1	0	0
13	2008-06-07	AA-TL	Northwest Arkansas Naturals		Arkansas Travelers	9-9		1.0	0	0	0	0	1	0	0
14	2008-06-10	AA-TL	Northwest Arkansas Naturals	@	Tulsa Drillers	7-8		2.0	2	1	1	0	2	0	0
15	2008-06-14 (2)	AA-TL	Northwest Arkansas Naturals	@	Springfield Cardinals	3-5		2.2	0	0	0	0	1	0	0
16	2008-06-17	AA-TL	Northwest Arkansas Naturals		Tulsa Drillers	8-9		1.1	2	1	1	0	0	1	0
17	2008-06-19	AA-TL	Northwest Arkansas Naturals		Tulsa Drillers	10-10		1.0	0	0	0	0	0	0	0
18	2008-06-21	AA-TL	Northwest Arkansas Naturals		Arkansas Travelers	9-9		1.0	2	2	1	1	0	0	0
19	2008-06-23	AA-TL	Northwest Arkansas Naturals		Arkansas Travelers	8-9		1.1	0	0	0	0	0	0	1
20	2008-06-27	AA-TL	Northwest Arkansas Naturals	@	San Antonio Missions	5-7		2.2	1	0	0	0	0	0	0
21	2008-06-30	AA-TL	Northwest Arkansas Naturals	@	Corpus Christi Hooks	6-9	S	4.0	1	0	0	0	4	0	0
22	2008-07-05	AA-TL	Northwest Arkansas Naturals		San Antonio Missions	6-7		2.0	2	0	0	2	0	0	0
23	2008-07-08	AA-TL	Northwest Arkansas Naturals		Corpus Christi Hooks	8-9		2.0	2	1	0	0	0	0	0
24	2008-07-10	AA-TL	Northwest Arkansas Naturals	@	Springfield Cardinals	9-9		0.1	2	1	1	0	0	0	0
25	2008-07-12	AA-TL	Northwest Arkansas Naturals	@	Springfield Cardinals	7-8	W	1.0	0	0	0	0	1	0	0
26	2008-07-14	AA-TL	Northwest Arkansas Naturals		Arkansas Travelers	9-9	S	1.0	2	0	0	0	1	0	0
27	2008-07-18	AA-TL	Northwest Arkansas Naturals	@	Springfield Cardinals	8-8		1.0	0	0	0	0	1	0	0
28	2008-07-21	AA-TL	Northwest Arkansas Naturals	@	Springfield Cardinals	10-13	W	3.2	3	0	0	0	5	0	0
29	2008-07-25	AA-TL	Northwest Arkansas Naturals		Springfield Cardinals	5-8	W	4.0	3	0	0	0	1	0	0
30	2008-07-29	AA-TL	Northwest Arkansas Naturals	@	Tulsa Drillers	8-9	S	1.2	2	0	0	2	0	0	0
31	2008-08-01	AA-TL	Northwest Arkansas Naturals	@	Arkansas Travelers	9-9	S	0.2	0	0	0	0	0	0	0
32	2008-08-02	AA-TL	Northwest Arkansas Naturals	@	Arkansas Travelers	9-9	S	1.0	1	0	0	0	1	0	0
33	2008-08-06	AA-TL	Northwest Arkansas Naturals		Midland RockHounds	8-9	S	2.0	1	1	1	0	0	0	0
34	2008-08-10	AA-TL	Northwest Arkansas Naturals		Frisco RoughRiders	9-9	S	0.1	1	0	0	0	0	0	0
35	2008-08-14	AA-TL	Northwest Arkansas Naturals	@	Midland RockHounds	9-11	L	2.1	1	1	1	1	2	1	0
36	2008-08-18	AA-TL	Northwest Arkansas Naturals	@	Frisco RoughRiders	8-8		0.2	0	0	0	0	0	0	0
37	2008-08-19	AA-TL	Northwest Arkansas Naturals		Springfield Cardinals	9-9		1.0	1	0	0	0	1	0	0
38	2008-08-23	AA-TL	Northwest Arkansas Naturals	@	Tulsa Drillers	8-9	S	1.2	1	0	0	1	3	0	0
39	2008-08-26	AA-TL	Northwest Arkansas Naturals	@	Arkansas Travelers	8-10	W	2.0	2	1	1	0	0	0	0
40	2008-08-30	AA-TL	Northwest Arkansas Naturals		Tulsa Drillers	9-9		1.0	0	0	0	0	1	0	0

Figure 3: Example of a game log publicly-available on baseball-reference.com. Each row symbolizes a game in which the player participated. The statistics used for pitchers (as shown in this example) were ER and IP.

Based on this cumulative ERA or AVG, a player was determined to be in a streak if his 5-game cumulative ERA or AVG was 33.3% better than his career average for that metric. He was determined to be in a slump if his 5-game cumulative ERA or AVG was 33.3% worse than his career average for that metric. Based on these calculations, the number of days in a streak or slump during a player's career was calculated. Also, the number of times a streak or slump started (meaning the current game was coded as a streak/slump and the previous game was not) was summed for a player resulting in a count of streaks and slumps. Subsequently, the frequency percentage of streaks and slumps was calculated by dividing by the number of game logs available online. Duration was calculated as the number of slump/streak days divided by the number of slump/streak starts plus four (since the start of a streak/slump indicated four days prior the actual slump or streak had begun).

Furthermore, data for players in the Mental Skills group were broken up into years where they worked with a Mental Skills coach (as indicated in the survey) and in years where they did not work with a Mental Skills coach. The same was done for streak and slump calculations on the individual game logs; the streak and slump frequency and average duration was also calculated in years where the player indicated they worked with a Mental Skills coach separately and in years where the player indicated they did not work with a Mental Skills coach. This resulted in a streak and slump frequency and duration for a player's full career as well as for Mental Skills periods and Non-Mental Skills periods (where log information was available).

Data Cleaning

For participants whose main position was a pitcher during their professional career, the statistic Earned Run Average (ERA) was used to measure their performance. Participants who were hitters used Batting Average (AVG) to measure their performance. Of the 135 qualifying participants, 83 were pitchers and 52 were hitters (Table 1). The range of ERA for pitchers was from 1.18 to 10.80, with a lower value indicating superior performance, and the range for hitters AVG was from .125 to .284, with a higher value reflecting superior performance (Figure 4). To normalize the data between to two statistics, the mean and standard deviation for the two samples was determined and used to convert a pitcher or hitter's ERA or AVG, respectively, to a measure of standard deviations from the mean. For example, a pitcher with an ERA of 3.05 is 1.10 below the mean of 4.15, which is 1 standard deviation better than 4.15 — since lower ERA is preferable — which would result in a measure of 1.0. A hitter with an AVG of .217 would be .029 points lower than the sample mean of .246, which is also 1 standard deviation from the mean, however in this case lower AVG signifies worse performance, so his resulting measure would be -1.0. Once these normalized measures were calculated, the full sample was examined for outliers. Seven of the 135 qualifying participants had a normalized career metric greater than 2 standard deviations from the mean, and their data was removed from the analyses, leaving 128 participants (Figure 5).

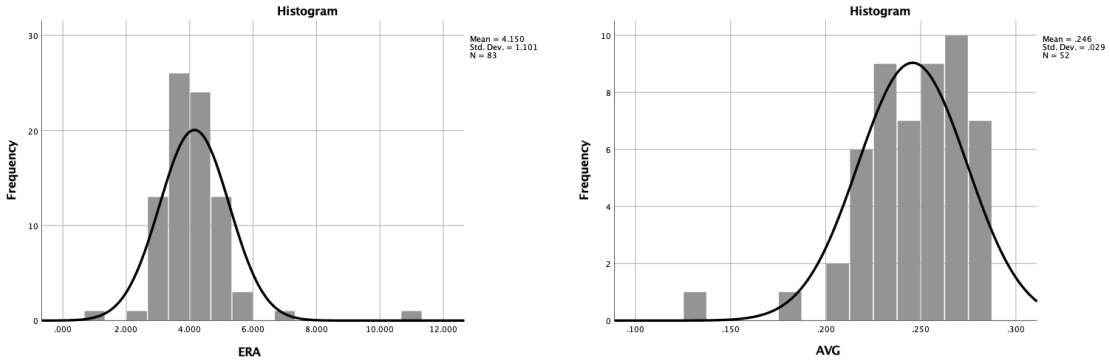


Figure 4: Histogram of the career ERA of all pitchers participants (left) and career AVG of all hitter participants (right) who met the inclusion criteria.

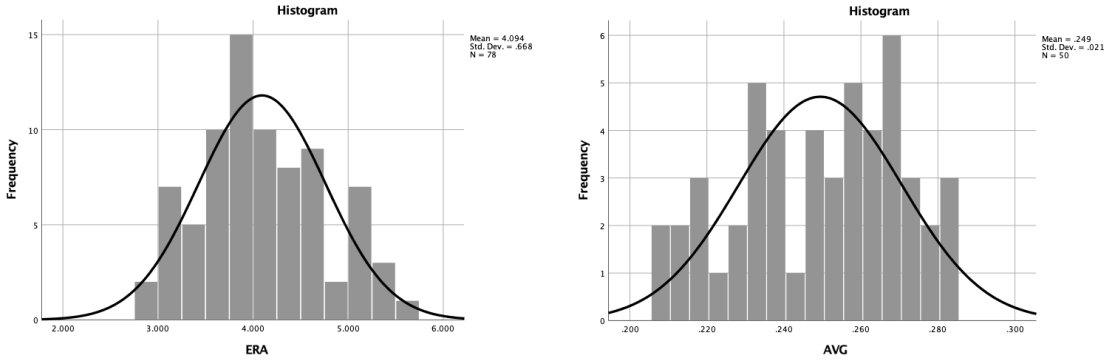


Figure 5: Histogram of the career ERA of all pitchers participants (left) and career AVG of all hitter participants (right) after removing outliers.

Table 1

Descriptive Statistics for Performance Measures

Full Population	**Pitchers (ERA)**	**Hitters (AVG)**
N	83	52
Minimum	1.18	0.125
Maximum	10.80	0.284
Mean	4.15	0.246
Variance	1.211	0.001
Std. Deviation	1.10	0.029
Std. Error of Mean	0.12081	0.00398
After removing outliers	**Pitchers (ERA)**	**Hitters (AVG)**
N	78	50
Minimum	2.76	0.208
Maximum	5.66	0.284
Mean	4.09	0.249
Variance	0.446	0.000
Std. Deviation	0.668	0.021
Std. Error of Mean	0.07511	0.00299

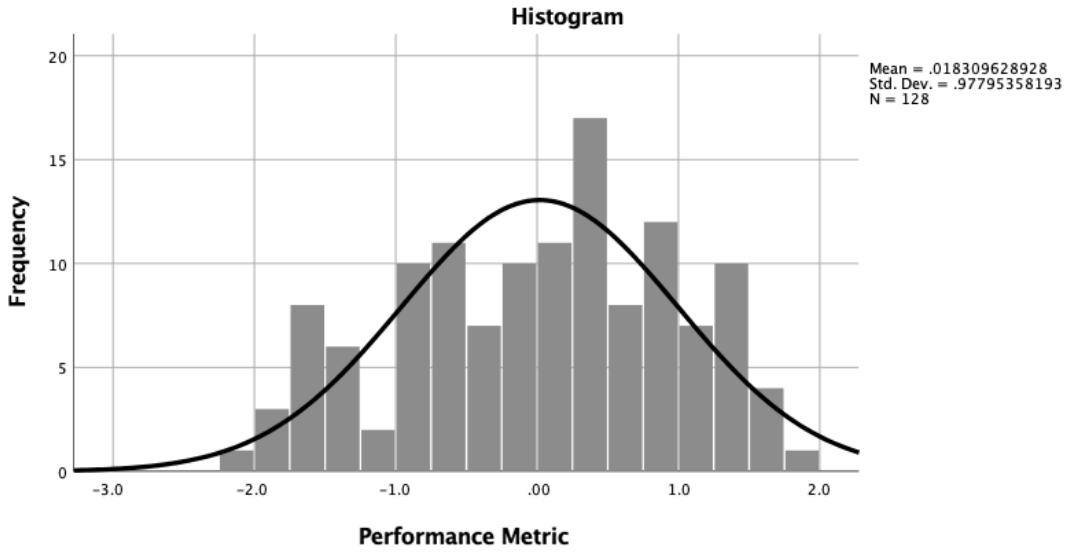


Figure 6: The combined normalized measure of standard deviations from the mean, or Performance Metric, calculated from pitchers' ERA and hitters' AVG. A Performance Metric value of zero indicates a player's ERA or AVG was equal to the sample mean. Values below zero indicate a player performed worse than average (higher ERA or lower AVG) and values above zero indicate a player performed better than average (lower ERA or higher AVG).

Table 2

Descriptive Statistics for Normalized Performance Metric

Normalized Dataset	**Performance Metric**
N	128
Minimum	-2.00
Maximum	2.00
Mean	0.018
Variance	0.956
Std. Deviation	0.978
Std. Error of Mean	0.0864

Data Analysis

Aim 1

The Mental Group binary variable — 1 if a player worked with a Mental Skills coach and 0 if he did not — was used in a linear regression with the Performance Metric. A multiple linear regression was also run to see how much of the variance in career performance was due to using a Mental Skills coach while holding other variables such as career length, highest level of play, and the number of years coached held constant.

Aim 2

Linear regressions with the Mental Group binary variable as the independent dummy variable and frequency of slumps, frequency of streaks, duration of slumps, and duration of streaks as the independent variable were run to determine if using a Mental Skills

coach improved any of these metrics. A paired-samples t-test would have been used to test within-subject difference in means for individual players comparing their Performance Metric to see if players performed better while working with a coach in comparison to when they did not work with a coach, however only one player had sufficient individual game log data for coach and non-coach time periods in his career, so this test could not be completed.

Aim 3

A multiple linear regression with tests of collinearity was run to determine if using a Mental Skills coach increased career length, while holding the number of years of college constant. To avoid selection biases, career length was then examined in bins created for the number of years into a player's career he began working with a coach. This allowed a true comparison of means across the Mental Skills / Non-Mental Skills groups to predict the expected career length of a player who had already played a given number of seasons when he decided to begin working with a Mental Skills coach.

Aim 4

A multiple linear regression with tests of collinearity was run to determine if using a Mental Skills coach increased a player's highest playing level. To avoid selection biases, highest playing level was then examined in bins created for the current playing level a player was at when he began working with a coach. This allowed a true comparison of means across the Mental Skills / Non-Mental Skills groups to predict the expected number of promotions of a player who had already reached a given playing level when he decided to begin working with a Mental Skills coach.

Aim 5

Simple linear regressions with the binary independent variable of whether or not a Mental Skills coach worked with a player and several ordinal dependent variables coded as the results of answers to Likert scales was run to determine the effect of a player's self-reporting of his career and post-career based on whether or not he worked with a Mental Skills coach.

Chapter III

Results

Of the 194 total participants, 59 were excluded from the analysis for failure to meet inclusion criteria. An overview of the career information for the sample is shown in Table 3.

Table 3

Participants Careers Overview

Mental Skills	
Mental Skills Group (%)	36 (26.7%)
Non-Mental Skills Group (%)	99 (73.3%)
Highest Level Played	
MLB (%)	12 (8.9%)
AAA (%)	27 (20.0%)
AA (%)	26 (19.3%)
A (%)	64 (47.4%)
Rookie (%)	6 (4.4%)
Career Statistics	
Career length in years: Mean (SD)	6.02 (3.667)
Years retired: Mean (SD)	13.31 (7.173)

Mental Skills Impact on Performance Metrics

Whether or not a player worked with a Mental Skills coach was not a significant predictor of a player's performance, as judged by his Performance Metric ($\beta = .046$, $t[127] = .237$, $p = .813$). Holding career length and level of play constant, working with a Mental Skills coach itself was not a significant predictor of performance ($\beta = -.228$, $t[127] = -.363$, $p = .719$). The full model of Mental Skills coach, career length, and level of play was also not a significant predictor of a player's performance ($p = .176$).

Whether or not a player worked with a Mental Skills coach was not a significant predictor of the frequency of slumps ($p = .941$), frequency of streaks ($p = .579$), duration of slumps ($p = .978$), or duration of streaks ($p = .644$) in a between-subjects linear regression run on the sample of 43 players who had game log data. A within-subject design was only possible on one hitter from the Mental Skills group, referred to as Player A, who had game log data for periods of his MLB career while working with a Mental Skills coach and the period of his career while he was not working with a Mental Skills coach that both exceeded 100 games. An in-depth look at the differences in metrics for Player A in periods where he was working with a Mental Skills coach compared to seasons where he was not working with a Mental Skills coach shows his batting average improved by 0.76 standard deviations (.016 points in batting AVG), and he performed more consistently overall with fewer and shorter slumps and streaks (Table 4).

Table 4

Within-Subject Mental Skills Coach Effect on Performance for Player A

Player A	**Not Coached**	**Coached**	**Improvement**
Batting Average (AVG)	0.248	0.264	0.016
Slump %	26.4%	20.5%	5.9%
Slump Duration (days)	5.1	4.9	0.2
Streak %	24.0%	22.3%	-1.7%
Streak Duration (days)	7.6	7.2	-0.4

A paired samples t-test was performed on players from the Mental Skills group to examine a difference in his Performance Metric when he was working with a Mental Skills coach compared to when he was not. Sixteen players played at least 25% of their career with a Mental Skills coach and within this sample a player's performance was, on average, 1.27 standard deviations above the mean better while he worked with a Mental Skills coach compared to when he did not (corresponding to an ERA 0.85 points lower or an AVG .027 higher). However, this one-sided t-test did not reach a level of significance ($t[16] = 0.97$, $p = 0.175$).

Mental Skills Impact on Career Length and Highest Playing Level

Players who worked with a Mental Skills coach played 2.3 years longer, on average, than players who did not work with a Mental Skills coach ($t[127] = 3.787$, $p < .001$). The number of years of college a player played was also a significant predictor of how long their professional career lasted, such that every year of college a player played

their professional career was shortened by 0.634 years, on average ($t[127] = -3.445$, $p = .001$). A multiple linear regression with years of college and whether or not a player worked with a Mental Skills coach as predictors showed the model was significant in predicting career length ($F[127] = 13.339$, $p < .001$), and the individual betas for years in college ($\beta = -0.588$, $t[125] = -3.344$, $p = .001$) and working with a Mental Skills coach ($\beta = 2.169$, $t[125] = 3.691$, $p < .001$) were significant. There were no significant collinearity between years of college and working with a Mental Skills coach (VIF = 1.005), which indicates that holding years in college constant, players who work with a Mental Skills coach as a professional have significantly longer professional careers, on average, than players who do not.

To determine if there was selection bias in looking at players' career length as a factor of whether or not they worked with a Mental Skills coach, the data was examined to determine at what point players began working with a coach and then comparing the average length of career *after* starting work with a coach in comparison to players who played at least as long as when the player began working with a coach. For example, if a player began working with a Mental Skills coach after playing 15 years and then went on to play 2 more years, his lengthy 17-year career can't be attributed solely to his work with a Mental Skills coach. To accurately compare the means, an analysis of how long players who played at least 15 years continued to play, on average, after their 15th year would be required.

On average, the 36 players who worked with a Mental Skills coach at some point in their professional career began working with their Mental Skills coach 3.06 years into

their careers, on average (SD = 3.91). Table 5 shows how long, on average, players within the sample continued to play after beginning working with a Mental Skills coach based on what year in their career their work with a Mental Skills coach began.

Table 5

Career Length Based on Working With a Mental Skills Coach

	Continued Career Length (in years)	
After X seasons	**No Mental Skills**	**Mental Skills**
0	5.6	5.0
1	4.6	5.2
2	3.6	2.0
3	2.6	6.2
4	2.5	6.3
5	2.3	5.0
6	2.1	4.0
7	2.3	7.0
8	1.9	3.0

Note: This table groups the average career length of players based on how many seasons they've already played to compare how much working with a Mental Skills coach increases the length of a player's future career. For example, a player from this sample who has already played 4 years (excludes any players with a career shorter than 4 years) will play an additional 2.5 years on average if he does not hire a Mental Skills coach. However, if he were to hire a Mental Skills coach after his 4th year playing, on average he would play an additional 6.3 years from that point, an average increase of 3.8 years of expected career length over a player who did not hire a Mental Skills coach.

A similar process was followed for examining highest level played. A simple linear regression of Mental Skills as the dependent variable and highest level played was statistically significant, such that players who worked with a Mental Skills coach reached a playing level 1.25 levels higher, on average than players who did not use a Mental Skills coach ($t[127] = 4.130$, $p < .001$). Players who worked with a Mental Skills coach on average reached a level slightly below Triple-A (an encoded level value of 2.87) whereas players who did not work with a Mental Skills coach reached a level between Single-A and Double-A, on average (an encoded level value of 1.62).

Again to determine how much of a factor selection bias was for these findings (i.e. players who reach higher levels may be more likely to have access to a Mental Skills coach, or more likely to possess the funds to afford one), the level at which a player was playing when he began working with a Mental Skills coach was recorded and compared to the highest level he eventually reached. On average, Mental Skills players began working with a Mental Skills coach at an average playing level of 1.39. Since this level is higher than the average level achieved by Non-Mental Skills players, it would be an unfit comparison to merely compare mean career length, and so just as it was with career length, the starting point at which a player began working with a coach was broken down by level in Table 6.

Table 6

Highest Playing Level Based on Working With a Mental Skills Coach

	Continued Playing Level Promotions (in levels)	
Starting Level	**No Mental Skills**	**Mental Skills**
0	1.21	1.75
1	0.70	2.73
2	0.59	1.75
3	0.21	0.33

Note: This table groups the average number of future promotions for players based on what level they are currently playing in. This is used to compare how much the use of a Mental Skills coach increases the *future* level attained by a player. For example, a player from this sample who is playing in Double-A (starting level encoded as 2, which excludes any players who never made it above Single-A) will go to play 0.59 levels higher on average if he does not hire a Mental Skills coach. If he were to hire a Mental Skills coach while in Double-A, on average he would get promoted 1.75 levels, an average increase of 1.16 levels of over a player who did not hire a Mental Skills coach. Two Mental Skills players in the sample began working with a Mental Skills coach after they had already reached level 4 (MLB), thus they were excluded from this analysis since there is no level above MLB.

On average, players who worked with a Mental Skills coach received 1.48 levels of promotions after beginning working with a Mental Skills coach. At every starting level (0 through 3) a player's expected number of level promotions was greater if he began working with a Mental Skills coach (Table 6).

Mental Skills Impact on Self-Report Factors

Players who worked with a Mental Skills coach during their professional career showed significantly stronger agreement, on average, with the statement “I got everything I could have out of my skillset” than players who did not work with a Mental Skills coach (t[127] = -2.673, p = .009). Additionally Mental Skills players reported that their off-the-field life impacted their on-field performance significantly more positively than players who did not work with a Mental Skills coach (Table 7).

Table 7

Self-Report Measures of Career and Post-Career Reflections

	Mean Scores			
	No Mental Skills	**Mental Skills**	**Test**	**p**
How would you rate your professional baseball experience overall? (1 = Positive, 7 = Negative)	2.01	2.10	t(127) = 0.371	0.711
How would you rate your on-field performance overall? (1 = Good, 7 = Bad)	2.83	2.64	t(127) = -.932	0.353
How did your off-the-field life (relationships and/or habits/activities) affect your on-field performance? (1 = Positively, 7 = Negatively)	4.21	3.57	t(127) = -1.987	**0.049**
How much do you agree with the statement: "I got everything I could have out of my skill set”	4.41	3.41	t(127) = -2.673	**0.009**

	Mean Scores			
	No Mental Skills	Mental Skills	Test	p
How much do you agree with the statement: "I should have been able to play longer than I did"	2.43	2.37	t(124) = -0.18	0.857
How much do you agree with the statement: "I should have reached a higher level (MLB, AAA, AA, etc) than what I did"	2.29	2.40	t(127) = 0.356	0.723
In regards to your post-baseball career, how well does this statement reflect your thoughts: "I have excelled in my professional life since baseball"	2.13	2.17	t(124) = 0.129	0.898
In regards to your post-baseball career, how well does this statement reflect your thoughts: "When my playing days ended, I was in a good position to succeed professionally"	3.83	3.51	t(127) = -0.805	0.422
In regards to your post-baseball career, how well does this statement reflect your thoughts: "When my playing days ended, I was in a good position to succeed personally"	3.41	2.87	t(127) = -1.474	0.143
In regards to your post-baseball career, how well does this statement reflect your thoughts: "My life is better today than it would have been had I not played professional baseball"	3.30	3.37	t(127) = 0.149	0.882

Note: All questions are 7-point Likert scales and are (1 = Strongly Agree, 7 = Strongly Disagree) unless otherwise indicated.

Players who did not work with a Mental Skills coach during their professional careers were prompted “If you were to have had a Mental Skills coach, it would have had the following effect on your career”. Figure 7 shows 75% of responses (69 of 92) indicated at least a slight anticipated benefit of working with a Mental Skills coach with only 8.7% (8 of 92) of participants anticipating a theoretical detrimental effect had they worked with a Mental Skills coach.

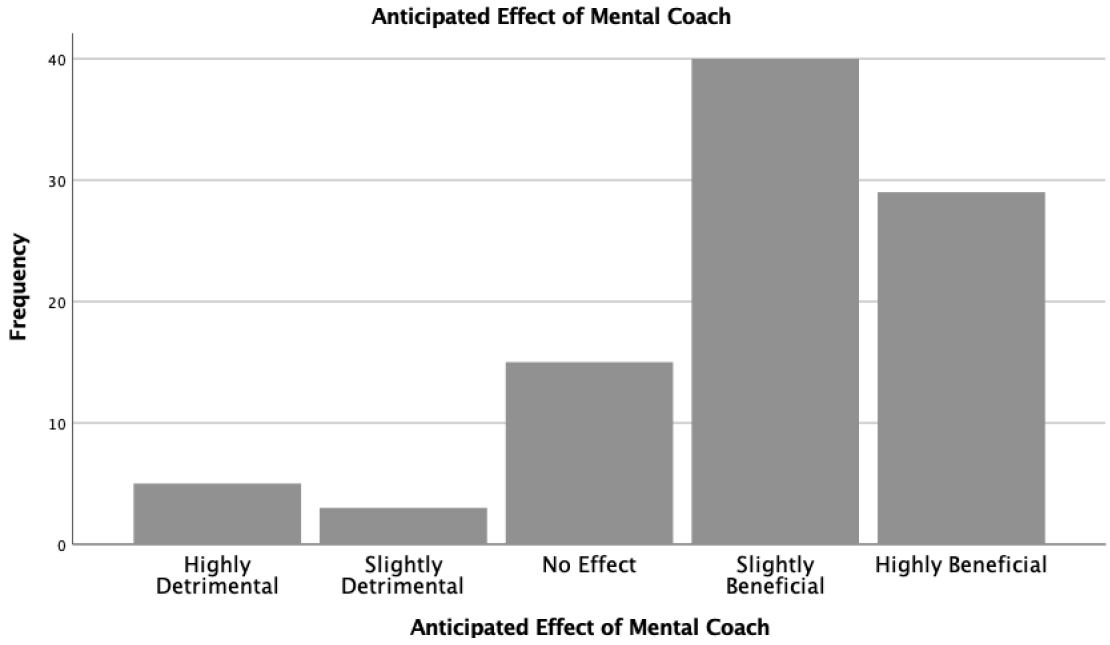


Figure 7: Players who never worked with a Mental Skills coach during their professional career were asked “If you were to have had a Mental Skills coach, it would have had the following effect on your career”

Chapter IV

Discussion

The research demonstrated the likelihood that a player who works with a Mental Skills coach during his professional baseball career plays significantly longer and achieves a significantly higher level of play than a player who does not work with a Mental Skills coach. Mental Skills players also reported significantly greater agreement with the statement “I got everything I could have out of my skillset” and responded significantly more positively to “How did your off-the-field life (relationships and/or habits/activities) affect your on-field performance?” These results provide significant support in the efficacy of Mental Skills coaches helping professional baseball players.

While the performance measures were not significantly better for Mental Skills players in this dataset, design flaws made it so that, at times, the exact opposite effect from what was intended may have been recorded. This confound makes it so that essentially no real determination can be made about the impact of Mental Skills coaching on statistical performance of professional baseball players, however there still were trends that give optimism for these effects existing with statistical significance when captured in proper conditions. Almost all performance measures were improved under Mental Skills conditions, however the effect sizes and sample sizes were such that findings were not significant. This leaves potential for future studies to improve upon this research and look more closely at ways to remove confounds and improve upon the

testing measures to make a solid statistical determination of a Mental Skills coach's impact on performance.

Performance Measures

The study's main hypothesis was that working with a Mental Skills coach would lead to improved statistical performance of professional baseball players. After data was collected and after unsolicited feedback from participants, it became clear there was an issue with the study's design in how it accounted for a player's performance under Mental Skills conditions. The study's survey asked players what years they worked with a Mental Skills coach. Players would indicate 4-digit years (ie. "2015"). Based on this input, any performance statistics for a player in 2015 were then counted towards — and attributed to — his Mental Skills performance. What quickly became evident was often times players would start out the 2015 season, as an example, with very poor statistics which would lead them to hire a Mental Skills coach. Since there was no way to know exactly when the player began working with the coach, it is likely that a portion of the data attributed to Mental Skills performance (since all 2015 data was attributed to Mental Skills) was, in fact, a biased selection of the worst stretches of a player's Non-Mental Skills performance. Put another way, the study aimed to test if working with a Mental Skills coach produced an effect of improved performance, and instead the study received data that poor performance produced an effect of working with a Mental Skills coach.

For example, if Player 1 began working with a Mental Skills coach prior to the 2015 season and went on to improved performance that year due to his work with the

Mental Skills coach, our data would record his improved performance in 2015 as Mental Skills performance and the increase would be indicated in the data. Another player, Player 2, may have chosen not to begin working with a Mental Skills coach at the beginning of the season and instead went on to significantly worse performance than what he was used to. After a few months of poor performance, he may have begun working with a Mental Skills coach, and then perhaps just before the 2015 season was completed, the player started to perform better. Based on the present study's design, Player 2's statistics for 2015 would *also* be recorded as Mental Skills performance. So two data points would show one player having significantly better performance due to working with a Mental Skills coach, while the other player would appear to have had significantly worse performance due to working with a Mental Skills coach, when in fact this was not the case at all. In both situations working with a Mental Skills coach was beneficial, statistically for both players 1 and 2, however our data collection methods were unable to detect this nuance. What's more, since theoretically a combination of situations like the Player 1 and Player 2 examples is likely our data only produces an average of Player 1 and Player 2's data, which will average out to essentially no change in performance.

Given the nature of baseball statistics where variations are minimal — for example, in this data set's entire range of 135 batting averages, the best hitter has only a 7.6% greater chance to get a hit, on average, in a given at bat than the worst batter — erroneously encoding a month or two of poor performance as "coached" performance

when in reality a player hadn't begun working with a coach yet would add a confound that might significantly impact the results of the studies.

Additional data collection methods were performed to try to parse out issues with the data after it had been collected and this issue was discovered. A paired samples t-test showed players with game logs available in their first year working with a Mental Skills coach performed .939 Performance Metrics worse in games during the first half of the calendar in which year they started working with a Mental Skills coach in comparison to the second half of that same year, however, this effect was not significant ($t[6] = .832$, $p = .219$). The direction and relative effect size given the small sample ($N = 7$) may support the theory that in many cases poor performance led to hiring a Mental Skills coach.

One particular player, "Player A," was the only player in the data set who was in the major leagues when he first began working with a Mental Skills coach after having not worked with a Mental Skills coach prior who also had game logs available. All 150 games in his first year working with the coach were available online. His case provides a perfect example of where the data — as it is encoded in this study — may be misleading. Since Player A has game log data for 150 games his first year with a Mental Skills coach, a simple linear regression determined that he performed significantly better as the season progressed with his batting average increasing, on average, by .022 every 30 days ($t[144] = 12.742$, $p < .001$). After the first 20% of the season, Player A was batting .212. For the final 80% of the season, he batted .309 (Figure 8). However, since our data only indicated he used a Mental Skills coach that particular year, all data for that year was encoded as "coached" performance.

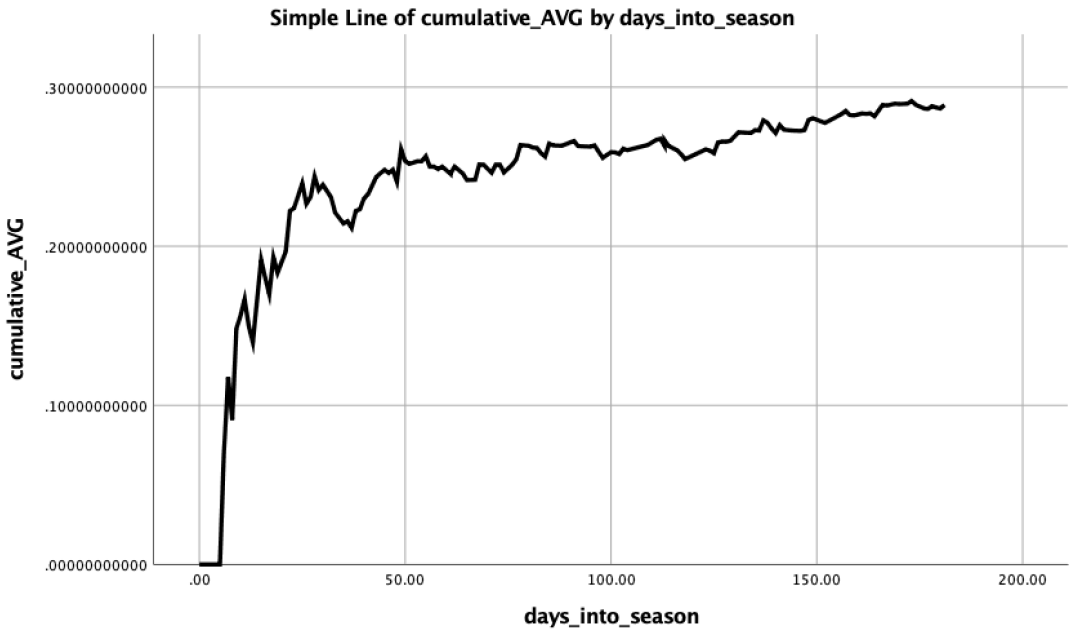


Figure 8: Player A in the first year working with a Mental Skills coach performed significantly better in the second half of the year. cumulative_AVG calculates the AVG of the player for the entire season, which makes raising the cumulative_AVG more difficult the further into the season the graph goes. Player A's AVG for the first 30 games was .211 and his AVG for the remaining 120 games was .309.

Though these trends were prevalent, they were not unanimous. Two of the seven players who had game log data for their first Mental Skills coached year hired their Mental Skills coach privately and both of those players significantly improved their performance over the season in a consistent manner. Four of the five players who were assigned a Mental Skills coach by their organization saw their performance decline during their first year, perhaps this is a result of the team assigning a Mental Skills coach after the player had already begun to struggle, or for other factors such as a negative impact on a player's confidence from the potential stigma associated with working with a Mental Skills coach. Since a private hiring of a Mental Skills coach would more likely happen during the year, this may indicate a time effect is involved, however this would need to be studied in a much larger sample size and with a design specifically to parse out this variance.

Career Length and Highest Level Played

Longer career length is a significant predictor of improved performance ($\beta = 0.69$, $t[127] = 2.175$, $p = .03$). Similarly, a higher level played falls just short of significance in predicting improved performance ($\beta = 0.151$, $t[127] = 2.901$, $p = .06$). Because of this, while it is significant and interesting to note that, working with a Mental Skills coach significantly increases a player's career length and highest level played (when compared only to players who have already reached the playing level of the player when he began

working with a Mental Skills coach), it also gives optimism to the idea that Mental Skills coaching may improve performance as well.

Becoming a Major League Baseball player is the goal of every professional baseball player. As difficult as it is to join the ranks of professionals, it is almost equally as difficult to move up through those ranks and become a Major League player. While this is a lifelong goal for the individuals, developing a Major League baseball player is also of supreme value to a baseball organizations. The average Major League baseball player salary was roughly $4,000,000 in 2018 (Blum, 2018). Due to the complicated structure of contracts and salaries, when a player is first promoted to the Major Leagues from an organization's minor leagues (Double-A or Triple-A), as of 2018, his salary is capped at roughly $550,000 (Brown, 2016).

If an organization can develop a player and promote him from within, in theory they can "save" almost $3,500,000 per year for the first two or three years of his contract over trying to sign a player to a free agent contract.

In our dataset, there were 48 players who began a season in Double-A. Of those 48, four players started using a Mental Skills coach that year. Three of the four Mental Skills players eventually made it to the Major Leagues (75%). Of the 44 players who did not use a Mental Skills coach at any point in their careers, only five (11%) eventually made it to the Major Leagues. While this is obviously a small sample size, the effects in Table 6 are positive across the board for Mental Skills coaching increasing the highest level played and warrant further study.

Self-Report of Career and Post-Career Reflections

Focusing first on the potential performance implications of the self-reported reflections in the study, the fact that Mental Skills players were significantly more likely to agree that they got everything out of their skill set implies potential performance increases from using a Mental Skills coach. Additionally, the fact that 75% of players who did not work with a Mental Skills coach said that working with one would have been beneficial to their performance supports the hypothesis of performance benefits from working with a Mental Skills coach.

Beyond the performance implications, however, these measures also indicate the personal benefits of working with a Mental Skills coach. A sense that off-the-field issues negatively affected your baseball career could lead to regrets or a difficult time coping with the way your career ended. Significant improvements in how positively a player feels about their off-the-field life during their playing career carries a value to the player that is difficult to quantify, but is substantial nonetheless. Another agree/disagree statement "When my playing days ended, I was in a good position to succeed personally" did not quite reach a level of significance, but still Mental Skills participants agreed more strongly with this ($\beta = 0.54$, $t[127] = -1.474$, $p = 0.143$).

Research Limitations & Future Directions

This study was conducted via self-report. Some participants were current players, and others were former (retired) players. The retired players were retired for a varying amount of time. It is possible the self-report provided by players who are recently retired

might vary from those who have been retired longer based on internal coping and/or the attributional style of the participant. To the question “Did you retire on your own terms?” only 47 of 123 (38%) responses answered “Yes”. Fifty-three participants (43%) were released and 23 (19%) participants’ careers were ended due to injury. With 62% of the sample ending their career not by their own choosing, the negative feelings or anger associated with the termination of their playing career may have lessened and faded over time, leading to a potential for differences in self-reports. Conversely, some of these players could harbor significant negative feelings about their departure from playing and these feelings could overshadow or contaminate their self-reflection regarding their careers and career satisfaction.

The recruitment for the study was performed exclusively on the online forum for the Professional Baseball Players association. While the forum had roughly 13,000 members from around the world at the time of the study — ranging in age from 20 to 85 — the number of living current and former players, while not known exactly, may be as high as 75k. It is possible this sample may not have been entirely representative of the full population.

The content of the recruitment text, as well as the majority of the content within the forum, was in English, and it is expected the majority of participants recruited will be native English speakers. The contents of the questionnaire were exclusively in English, however, more than 30% of the population of professional baseball players are non-English speakers (Armour & Levitt, n.d.).

In terms of the statistical measures of the group, the sample is very representative of professional baseball players. In the Major Leagues during the 2018 season, the AVG of all players combined (over the course of more than 165,000 at bats) was .248. Over more than 43,000 innings pitched, the league's cumulative ERA of all pitchers was 4.15. Our original sample's AVG was .246 and the original ERA was 4.14. After removing outliers and incomplete data, the means used were .249 and 4.09 for AVG and ERA respectively. This makes the full data for all Major League baseball differ by only .09 standard deviations in ERA and by only .05 standard deviations in AVG, indicating a very representative dataset.

The categorization of Coaching and Non-Coaching grouped multiple types of coaching together. This study aimed to group players based on whether or not the player (or their team) employed a special coach to train them in Mental Skills. If a player had a coach who was specifically his hitting coach, but he helped the player with mental aspects of his hitting, this coach will not be counted as a specific Mental Skills coach. The line between who was a Mental Skills coach and who was not is a difficult one to draw, and the most clear-cut way to do so was by defining a Mental Skills coach as a specific coach hired to train in Mental Skills. However, this is not a perfectly cut and dry solution.

Additionally, different types of Mental Skills coaches can be hired, and while a survey question aimed dissect which type of coach each participant had, there is significant overlap. What's the difference between a sports psychologist and a Mental Skills coach? What if my sports psychologist also does mindfulness training? All

statistical analyses using dummy variables for the different types of coaches did not produce significant differences in efficacy of coaches based on the type. Further research may be able to more closely examine this phenomenon with a larger sample size and more specific definitions, delineations, and categorization of coaching types.

While the sample size far exceeded the target sample, there were many analyses for which only parts of the dataset had complete data. For example, when looking at players who had individual game log data for games during the season of their first year working with a Mental Skills coach, only seven players met the criteria. A sample size of almost 200 respondents was funneled down to much smaller samples in many cases with this data, specifically with the sporadic availability of single game logs available online for a player. The post advertising the link to the survey was taken down after 40 minutes due to the overwhelming number of respondents and the budget available to cover the $20 coupon to the online store. Future research, with a larger budget could theoretically gather significantly larger sets of data as the forum for the PBPA is a very active group.

Perhaps most importantly, the data collection methods had serious flaws when attempting to categorize performance data as data during a time period where the player was working with a Mental Skills coach and when he was not. A random assignment design with surveys given in a time series could be more effective and efficient and parsing out the variance due to Mental Skills coaching. At the minimum, a study attempting to replicate this data should be more careful to specifically find out when a player began working with a Mental Skills coach during a season.

Lastly, the study was quasi-experimental because there was no random assignment to groups, rather the answers to particular questions within the questionnaire determined a participant's group. Ideally, a design with random assignment would allow for much more confidence in measuring intended variations. As discussed above, this dataset suffered by not knowing when a player started working with a coach within a given year. In addition to this lack of clarity, there was the issue with "how quickly does working with a Mental Skills coach start to show benefits?" If, for example, it takes a number of months, or a full year to see improvements, the present study does not account for any time delay in that regard either.

Present limitations aside, there have not been many studies, if any, with this amount of data available from professional athletes. The results overwhelmingly point to the efficacy of Mental Skills coaching in improving certain metrics associated to career success, both performance-based and personally. With the knowledge of the limitations of this study's design, more research within professional baseball is pertinent to understand exactly how Mental Skills coaching impacts high-performing professional baseball players.

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