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ANALYSIS OF EFFECTIVE SCORING STRATEGIES IN COLLEGIATE WRESTLING

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ANALYSIS OF EFFECTIVE SCORING STRATEGIES

IN COLLEGIATE WRESTLING

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We recommend acceptance of this thesis in partial fulfillment of the candidate's requirements for the degree of Master of Science in Exercise and Sport Science: Physical Education Teaching- Adventure Education Emphasis.

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ABSTRACT

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The purpose of this study was to identify the most influential scoring strategies by different weight categories in collegiate wrestling. The secondary purpose was to develop an equation model to predict winning a wrestling match. Fifteen college wrestlers from two NCAA Division III colleges in the upper Midwest participated in this study. Fourteen factors were chosen by the researcher based on past research, coaches' suggestions and theories to their relationship to winning a collegiate wrestling match. The data was collected to identify each factor during the matches of the participating wrestlers from the 2015-2016 wrestling season. A Chi-square test (χ^2) was performed to find the relationship between each variable and the outcome of the wrestling match for all the data and for each of the 4 weight categories individually. Riding Time (Φ=.574), Scoring Last in a Period (V=.569), Scoring Takedowns (V=.568), and First Takedown (Φ =.557) had the largest effect sizes and were all significant (p<.001) to winning. A multiple logistic regression was performed to investigate the relationship of all the factors to winning. Riding Time, First Takedown, 3rd Period Points, Mat Control, and 4 point Near Falls were included in the final equation to best predict a winning match.

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INTRODUCTION

Collegiate sports have become popular and continually more competitive as training methods, technology and knowledge of the sports evolve. This evolution of sports is spurred on by continual research. One of the most intriguing areas of study may be that of sports strategy because there are many opinions on best strategy. Different strategies arise from different cultures, rules, and personalities of both coaches and the participating athletes. Coaches and athletes may believe that they employ the best strategies, and thus it is compelling to explore which strategies actually lead to the most scoring opportunities and wins.

Numerous studies have been done in different sports regarding what strategies and methods are the most effective for scoring points and winning games. For instance, soccer, one of the world's most popular sports, has an abundance of literature regarding the most effective strategies for scoring points. These strategies include location of free kicks, field positions, attacking vs. defending tendencies, and the effects of penalties on winning (Ruiz-Ruiz, Fradua, Fernández-GarcÍa, & Zubillaga, 2013). Similar strategic analysis can be found in the sports of basketball (Ortega, Palao, Gómez, Lorenzo, & Cárdenas, 2007), water polo (Mirvić, Kazazovic, & Aleksndrovic, 2015), and gymnastics (Massidda & Calò, 2012). However, very little is known about scoring strategies and factors (e.g., winning a match) within the sport of wrestling.

Wrestling is often revered as one of man's oldest sports, and it becomes more competitive than it has ever been because of perfection in techniques and training: methods as well as the implementation of new rules (Chapman, 2005). Thus, it is critical for coaches to be educated on the best strategies of the sport. Baić, Karninčić, and Šprem (2014) found that there are specific ages and years of experience needed to win a Gold medal at the World Championships in wrestling within each weight class; however, this study focused on international style wrestling, which has different rules than American collegiate style wrestling. Farwell (2013) explored scoring strategies of collegiate wrestlers and found that many of the anecdotal theories like scoring first and achieving riding time were true. However, different weight categories were not considered on those strategy factors. Each of the weight categories carries with it different strategies and styles, and thus it would be beneficial for the research to show how each strategy corresponds to each weight category (Baić et al., 2014). Also, Farwell (2013) used a small sample that would need to be broadened. To continue to build off of this research, a bigger sample should be collected from several schools to allow for variations in technical styles and training styles.

The NCAA has implemented several new rules since the research of Farwell (2013) and many of these new rules are likely to have an effect that may change his findings. For instance, when Farwell's research was done, two near fall points were awarded to the top wrestler when he was able to expose his opponents back to the mat for two seconds and three points were awarded if he could expose his opponents back for five seconds. Now a wrestler still receives two points for two seconds of exposure, but he also receives four points for four seconds of exposure. This would indicate that

getting near fall points would have a bigger impact now than it did during Farwell's research. There have also been attempts to increase action within a match and decrease passivity during matches and this change may affect the impact of stalling calls on the outcome of a match. Referees are now encouraged to call stalling more frequently at the edge of the mat when both wrestlers are in the neutral position. It is likely that this change will make mat control and scoring on the edge of the mat more important for winning a wrestling match. In addition, referees have been instructed to call stalling on the top wrestler when they are in certain positions (holding an ankle, in headlock off to the side, and when dropping down to the legs) in order to create more action from the top position. This new rule would change the abilities of some wrestlers to ride their opponent. Although these rules are constantly being amended to make the sport more exciting and competitive, anecdotal theories have still long persisted in wrestling.

Coaches and wrestlers have preached many different anecdotal theories, throughout the years, about what scoring strategies are the most important for winning matches. A few popular theories include scoring first in the match, achieving riding time bonus, scoring near fall points, scoring on the edge of the mat, controlling the mat area, achieving stalling points, scoring at the end of a period, and leading in the second and third periods. Due to a variety of strategies and factors for winning in wrestling, research efforts may be necessary within the sport to continually make it more competitive and to keep up with the changes in rules that occur throughout the years. However, these anecdotal theories have not been thoroughly examined through scientific process, and as a result there is a scarcity of evidence on what scoring strategies are more associated with winning in wrestling. Thus, the effective scoring methods and strategies based on the new

rules need to be further explored to increase strategic knowledge to compete in wrestling, as well as to show the efficacy of the anecdotal theories. This research effort would help coaches better implement the proper techniques and strategies to make their wrestlers more competitive in the sport.

The primary purpose of this study was to identify the most influential scoring strategies by different weight categories in collegiate wrestling athletes. The secondary purpose was to develop an equation model to best predict winning a wrestling match. With this knowledge, coaches will be able to tailor their programs to specifically work on the scoring strategies that have the biggest impact on winning. It is hoped that this study helps coaches to teach the most effective techniques and strategies to make their wrestlers more competitive in the sport. *Assumptions*

1. Athletes gave high amounts of effort during the matches that will be videotaped.
2. Athletes gave thorough knowledge of the current wrestling rules.
3. The coding system was valid to observe the proposed scoring strategies.

Delimitations

1. The samples were recruited from two NCAA Division-III universities from the upper Midwest.
2. The study will only focused on American Collegiate wrestling.

Limitations

1. The observation angles of the games were somewhat limited because only one video camera was used to record the games.
2. The selection of the sample was dependent upon the head coach's selection from each team.

Operational Definitions

1. Scoring on the Edge: This factor measures the amount of times a wrestler scores on the edge of the competition circle. The edge of the circle is a strategic position because a wrestler can establish a fresh start in the center of the mat by going out of bounds, so it is important that a wrestler is able to score on the edge, rather than allow his opponent to go out of bounds. In this study, a score on the edge will be considered any score that occurs while any part of either wrestler is outside of the competition circle.
2. Scoring First: This shows who scores first in the match. Traditionally it is the thought that the wrestler who scores fist has the advantage because they take the immediate lead in the match.
3. Scoring at the Beginning of a Period: This factor establishes if a wrestler scored within the first fifteen seconds of a period. Scoring at the beginning of a period establishes a lead that the other wrestler must make up.
4. Scoring at the End of a Period: This factor establishes if a wrestler scored within the last fifteen seconds of a period. Scoring at the end of a period gives the possibility of unanswered points from the opponent.
5. Mat Control: Control of the competition area is measured in many martial arts. The competitor most often given credit for control of the competition area is the wrestler who is determined to have their back to the center of the ring rather than the outside most often during the match
6. Scoring Last in a Period: Scoring last in a period allows the wrestler to have unanswered points in the match. This will be a distinct code from scoring at the

end of the period because the last score may occur before the last 15 seconds of a period.

7. Shot Attempts: The amount of attempts a wrestler takes to secure a takedown on his opponent via traditional leg attacks. A shot attempt is described as any legitimate attack with intention to score on the opponents legs (not a fake or half shot).
8. Riding Time: The advantage time a wrestler accrues for maintaining control of his opponent. When the end of a match is finished and a wrestler has 1 minute or more of riding time, that wrestler receives a point.
9. Stalling Warning: When the referee determines that one wrestler is not making an active attempt to score, he may call that wrestler for stalling. For the second and subsequent warnings, the wrestler's opponent is granted one point. This is the only code that will occur for the opponent of the wrestler, as it measures the coded wrestlers aggressiveness.
10. Near Fall Points: The points a wrestler receives for exposing his opponents back to mat for 2 or 4 seconds.
11. Third Period Points: A factor that measures the amount of points a wrestler scores in the third period. As it is the last period of the match, it is important for a wrestler to score as many points as possible in the third period. This also may show which wrestler has the better aerobic conditioning.
12. Collegiate Wrestling (folkstyle or scholastic wrestling): A style of wrestling only practiced in America

METHODS

Participants

15 elite Collegiate Wrestlers from two Division III schools in the Northern Midwest were conveniently recruited for this study. These schools were chosen because they represent two of the most successful schools in Division III wrestling and were willing to participate in the study. The coaches from each program chose the wrestlers to be observed to ensure that their more elite wrestlers were represented. Study approval was obtained from the university institutional review board.

Instruments

The matches were coded using a modified version of Farwell's coding tool (2013). The event (i.e., frequency) and duration (i.e., length) recording tactics were used in the coding system. The factors that were coded included: (1) scoring points on the edges of the mat (SE), (2) scoring the first takedown in the match (FT), (3) scoring in the first fifteen seconds of a period, (4) scoring in the last fifteen seconds of a period, (5) mat control, (6) scoring last in a period (SL), (7) shot attempts (A), (8) riding time, (9) stalling warnings (S), (10) near fall points (NF), as well as distinguishing between (11) 2 point near falls and (12) 4 point near falls, (13) third period points, and (14) takedowns. Shot attempts were the amount of leg attacks a wrestler made when in the neutral position. Riding time was the advantage time (worth 1 point) a wrestler received for being in the top position at least 1 minute longer than his opponent. Stalling warnings occur when the referee determine that one wrestler is not actively attempting to score, he will warn a

wrestler for stalling and then award the other wrestler 1 point for the second and subsequent stalling warnings. This study will observe how many stalling warnings were given to the wrestler's opponent, because many coaches consider this to mean that their wrestler is demonstrating an aggressive style of wrestling. Near Fall points are the points a wrestler receives for exposing his opponents back to the mat. A wrester receives 2 points for 2 seconds of exposure and 4 points for 4 seconds of exposure. Mat control was determined using stopwatches to observe which wrestler had their back to the center of the mat the longest. This showed which wrestler controled the mat area the most in the match. The coding tool is shown in Appendix C.

Procedures

Trained staff videotaped the entirety of each match in each team. Each wrestling match is seven minutes long and consists of three periods. In the event of a tie, overtime periods were implemented. Only the participant's actions were coded and the opponent's actions were not coded. The films were then be analyzed to assess how many times or how long each factor occured within the match. When the videos of the matches were watched, they were coded with a tally system to find the occurrence of each factor (scoring points on the edges of the mat (SE), scoring the first takedown in the match (FT), scoring in the first fifteen seconds of a period, scoring in the last fifteen seconds of a period, scoring last in a period (SL), shot attempts (A), stalling warnings (S), near fall points (NF), as well as distinguishing between 2 point near falls and 4 point near falls, third period points, and takedowns) and timed using a stop watch (mat control and riding time).

Analysis

For both research purposes, predictor variables were the 14 scoring strategies and the outcome variable was winning the wrestling match. To examine the strength and significance of the relationships between the predictor and outcome variables, Chi-square tests (χ^2) were used because the outcome variable is binary (i.e., yes or no) and all predictor variables use frequencies for individuals classified into one of four weight categories. The effect size was measured using the phi-coefficient (Φ; only for 2 by 2 matrix)) and Cramer's V (larger than 2 by 2 matrix). When interpreting the Φ and Cramer's V, standards of Cohen (1988) were used: for df=1, .10 small effect, .30 medium effect and .50 large effect. For the second research purpose, a multiple logistic regression was employed to find the best equation model to predict winning a collegiate wrestling match. Based on the results of Chi-square test (χ^2), all predictors that had a p-value of less than 0.25 were included in the potential models to be tested (Hosmer, Lemeshow, & Sturdivant, 2013).

RESULTS

Chi-square (χ^2) results for the fourteen variables confirmed that ten of the fourteen variables had a significant occurrence to winning a wrestling match. The test revealed that First Takedown (Φ=.557), Takedowns (V=.586), Near Falls (V=.470), 4 point Near Falls (V=.462), Scoring in the First 15 seconds in a Period (V=.323), Scoring the Last 15 seconds in a Period (V=.393), Riding Time (Φ=.574), Scoring in the Third Period (V=.431), Scoring Last in a period (V=.569) and Mat Control (Φ=.470) all were significantly associated with winning a college match (p<.05). When broken down by weight category, several factors stood out to be more important at different weights than others. For Light Weights (125-141) Near Falls (V=.626), 4pt Near Falls (V=.626), Riding Time (Φ=.474), Scoring Last in a period (V=.750) and Mat Control (Φ=.734) were all significantly associated with winning a match. For Light-Middle Weights (149-165) First Takedowns (Φ=.693), Takedowns (V=.687), Near Falls (V=.457), 2 point Near Falls (V=.295), 4 Point Near Falls (V=.393), Scoring in the Last 15 seconds of a Period (V=.548), Riding Time (Φ=.555), Scoring in the 3rd Period (V=.586) and Scoring Last in a Period (V=.595) were all significantly related to winning a college match. For Heavy-Middle Weights (174-197) First Takedowns (Φ=.537), Takedowns (V=.508), 4 point Near Falls (V=.477), Scoring in the First 15 seconds of a Period (V=.494), Riding Time (Φ=.696), Scoring Last in a Period (V=.614), and Mat Control (Φ=.432) were all significantly associated with winning a match. For Heavyweights (285) First Takedown (Φ=.896), Takedowns (V=1.000), Riding Time (Φ=.559), Scoring Last in a Period

(V=.650), and Mat Control (Φ=.505) all had significant associations with winning a match. Only Riding Time and Scoring Last in a Period were significant in all weights. First Takedowns and Takedowns were significant for all weight classes except for Lightweights. 4 point Near Falls were significant for all weights except for Heavyweight. Mat Control was significant for all weights but Light-Middle Weights. All the variables can be seen in Table 1 below.

Table 1. Chi-square tests (χ^2) on Variable

	Light Weights		Light Middle Weights		Heavy Middle Weights		Heavy Weights		All Weights	
Variable	*p*-value	Effect Size	*p*-value	Effect Size	*p*-value	Effect Size	*p*-value	Effect Size	*p*-value	Effect Size
First Takedown	.066		*<.001	Large	*.003	Large	*<.001	Large	*<.001	Large
Takedowns	.085		*.001	Large	*.022	Large	*<.001	Large	*<.001	Large
Shot Attempts	.068		.408		.176		.722		.752	
Scores On the Edge	.451		.654		.231		.126		.371	
Near Falls	*.007	Large	*.034	Medium	.091		.202		*<.001	Medium
2pt Near Falls	.214		*.032	Small	.271		.418		.055	
4pt Near Falls	*.003	Large	*.048	Medium	*.028	Medium	.297		*<.001	Medium
Scoring in the First 15 Seconds	.194		.101		*.011	Medium	.225		*.001	Medium
Scoring in the Last 15 Seconds	.569		*.012	Large	.061		.445		*.001	Medium
Stalling Calls	.219		.555		.883		.156		.442	
Riding Time	*.023	Medium	*<.001	Large	*<.001	Large	*.015	Large	*<.001	Large
Third Period Points	.084		*.016	Large	.053		.337		*.008	Medium
Scoring Last in the Period	*.001	Large	*.004	Large	*.004	Large	*.028	Large	*<.001	Large
Mat Control	*<.001	Large	.072		*.025	Medium	*.046	Large	*<.001	Medium

*p<.05

To predict winning with an equation of the variables a multiple logistic regression was used. The predictors to be included in the potential models were First Takedown, Takedowns, Near Falls, 2 point Near Falls, 4 point Near Falls, Scoring in the First 15 seconds in a Period, Scoring the Last 15 seconds in a Period, Riding Time, Scoring in the Third Period, Scoring Last in a period and Mat Control because they all had a p-value less than .25. After running multiple models, the factors with the most predictability and significance included: Riding Time (p=.003), First Takedown (p<.001), 3rd Period Points (p=.038), Mat Control (p=.035), and 4 point Near Falls (p=.038). The equation model was Win= 0.254(Riding Time) +0.385(First Takedown) +0.039(3rd Period Points) +0.164(Mat Control) +0.127(4pt Near Falls) +0.140. These variables statistically significantly predicted winning a collegiate wrestling match, F (5, 84)= 22.869, p<.001, R^2=.576. All five variables added statistically significantly to the prediction, p<.05. The equation data can be seen in Table 2 below.

Table 2. Output from Logistic Regression

Variable	B-Coefficient	β-Coefficient	Standard Error	p-value
Riding Time	.254	.265	.084	.003
First Takedown	.385	.408	.073	<.001
3rd Period Points	.039	.176	.019	.038
Mat Control	.164	.168	.077	.035
4pt Near Falls	.127	.172	.060	.038

DISCUSSION

The findings in this study showed that Riding Time (.574), Scoring Last in a Period (.569), Scoring multiple Takedowns (.568), and Scoring the First Takedown (.557) had the largest effect sizes and were all significant (<.001) to winning a collegiate wrestling match. When the factors were looked at in different weight categories, some factors stood out more than others. For Light Weight wrestlers (125-141) the most significant (<.05) factors with the largest effect sizes were Scoring Last in the Period (.750), Mat Control (.734) , and Near Falls (.626), particularly 4 point Near Falls (.626). For Light Middle Weights (149-165) the factors that were all significant (<.05) that had the largest effect size were multiple Takedowns (.687), First Takedown (.639), Scoring Last in a Period (.595), Third Period Points (.586), Riding Time (.555), and Scoring in the Last 15 Seconds of a period (.548). For Heavy Middle Weights (174-197) the factors, that all were significant (<.05) that had the largest effect sizes were Riding Time (.696), Scoring Last in a Period (.614), First Takedown (.537),and multiple Takedowns (.508). For Heavyweights (285) the factors that were significant (<.05) with the largest effect size were multiple Takedowns (1.000), First Takedown (.869), Scoring Last in a Period (.650), Riding Time (.559), and Mat Control (.505).

After a multiple logistic regression analysis was performed to investigate the relationship of each of the predictors to winning a collegiate wrestling match. First Takedown, Takedowns, Near falls, 2 point Near falls, 4 point Near falls, Scoring in the 1st 15 Seconds of a period, Scoring in the Last 15 Seconds of a period, Riding Time, 3rd

Period points, Scoring Last in a Period and Mat Control were all included as possible predictors for the equation. The model revealed that Riding Time, First Takedown, 3rd Period points, Mat Control, and 4 point Near falls were the best predictors of a winning match.

The results of this study could be used by coaches of collegiate wrestling to help them focus on the most influential aspects of the sport to improve their athlete's chances of winning. Because Scoring Last in a Period has such a high effect size both overall and in each weight category, coaches should put an emphasis on their athletes Scoring Last in each period because it gives the athlete a statistically better chance of winning. This would require the coaches to instill a mentality to continue scoring, even after being scored upon, or to hang on to and possibly build on a score that they just procured. With Riding Time being the most influential factor in the regression, a coach may choose to focus more of his instruction on riding techniques and the top position. This would also give the athletes more opportunities to have the last score in a period and to obtain near fall points. In the neutral position, coaches may look to improve their athlete's ability to score takedowns and be more aggressive about getting the first takedown. Both factors showed a statistical advantage in winning a match, so improving an athlete's ability to obtain takedowns and get the first one greatly improve their chances of winning. This could be looked at from a defensive perspective as well. If a wrestler is not proficient at scoring from their feet, perhaps their best strategy would be to avoid being scored on in the first period until they can be started on the mat in the second and third periods. This would also allow them to work on getting mat control, another strong predictor to winning a match. A coach might strengthen their athlete's ability to get mat control by

emphasizing the skill of moving their opponent and controlling ties. Lastly, according to this data, a coach would want to focus on conditioning of their athletes so that they have more energy to score in the 3rd period of a match and therefore get more 3rd period points.

Athletes may look at this data to find which factors are the most important for their weight category and use that to tailor their training to improve their ability to achieve those factors. For example, a wrestler in the Light Weight category would want to increase their proficiency in top position wrestling. This would allow them to have a better chance of scoring near falls, scoring last in each period, and achieving riding time. In the neutral position, the factor that would most improve their chances for winning would be getting mat control. This would indicate that they should focus most on controlling their opponent's position through hand fighting.

Future research should continue to include more teams and a larger sample size to diversify the wrestling styles and to strengthen the data. If a large enough sample can be obtained, it would be interesting to have the data analyzed by weight class, rather than weight category. Future researchers are encouraged to look for more variables to study to find other factors that may influence the outcome of a wrestling match. Other interesting aspects of this research would be to explore the outcome in different divisions of the NCAA (I, II, and Junior College). In addition, many coaches would be interested to have similar research done on high school with a modified coding tool. One could also make a similar coding tool with different factors for the International styles of wrestling (Greco-Roman and Freestyle).

This study contributes to the research done by Farwell (2013) that established the predictors with the greatest influence on winning a collegiate wrestling match, and also

provides a direction for future researchers in the sport to gain more knowledge of the most influential predictors that have an effect on the outcome of the wrestling match.

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APPENDIX A

REVIEW OF LITERATURE

LITERATURE REVIEW

In our current culture, collegiate sports have become very popular and continually become more competitive as training methods, technology and knowledge of the sports evolve. This evolution among sports is spurred on by continual research to verify the best strategies, training methods, injury preventions and technologies within each individual sport.

One of the most interesting areas of study is that of sports strategies. This subject is intriguing because of the many different opinions on it. Different strategies arise from different cultures, rules, and personalities. Every coach and athlete believes that their strategies are the best. Because of this, the exploration of the strategies that actually lead to the most goals and wins is necessary.

Literature exists in many sports regarding what strategies and methods are the most effective for scoring points and winning games. Soccer, as one of the world's most popular sports, has a lot of literature regarding the most effective strategies for scoring points. These strategies include location of free kicks, field positions, attacking vs. defending tendencies, and the effects of penalties on winning (Ruiz-Ruiz, Fradua, Fernández-GarcÍa, & Zubillaga, 2013). Similar strategic analysis has been done in the sports of basketball (Ortega, Palao, Gómez, Lorenzo, & Cárdenas, 2007), water polo (Mirvić, Kazazovic, & Aleksandrovic, 2015), and gymnastics (Massidda & Calò, 2012).

Wrestling is often revered as one of man's oldest sports, however there is minimal research regarding the effective scoring methods and strategies used in wrestling (Chapman, 2005). There is one previous research study that looked at the effects of

scoring strategies on winning; however, it took a very narrow sample size that would need to be broadened to prove its efficacy (Farwell, 2013).

The sport of collegiate wrestling is as competitive as it ever was. Some would contend that it is more competitive than it has ever been because of the perfection of techniques and training methods over the years. This would indicate that research is more important now than it ever was. Throughout the years coaches and wrestlers have preached many different anecdotal theories about what scoring strategies are the most important for winning matches. Due to the lack of research in the field of scoring strategies for wrestling, it would advance the sport greatly to get as much research as possible that would show the efficacy of these anecdotal theories.

This review will focus on different articles that have measured the effectiveness of scoring strategies in sports. These articles fall into several different categories that will aid in the development of new research to further our understanding of wrestling strategies. The categories include current research that pertains to the sport of wrestling, the impact of scoring areas on success in sports, the impact of penalties on success in sports, the impact on control on success in sports, and how scoring strategies are measured.

Wrestling History and Strategy Research

Wrestling is often held in the regard that it is a dying sport. With it being a long time amateur sport in the US with no successful attempts at a professional league, and countless programs being discontinued in high schools and colleges due to Title IX, it is easy to see why this tends to be a common view. However, research shows that this simply is not the truth (Destani, Hannon, Podlog, & Brusseau, 2014). Destani et al.

(2014) explored the effects of implementing wrestling into a high school Physical Education curriculum utilizing the Teaching of Personal and Social Responsibility (TPSR) method. In order to go through with this research, the researcher had to submit a case for the importance of wrestling. Because of this, this article provides the history of wrestling and the important lessons students of the sport can learn from its participation. This idea is easily extrapolated to the proposed research question to show the importance of wrestling within our current culture. Not only does it show the importance to the current culture, but it also shows the importance of continued research in the field. However, there was no information that pertained to what factors would lead to success in wrestling.

(Baić, Karninčić, and Šprem, 2014) sought to discover what factors related most to wrestlers winning a world championship in their particular weight category. The factors they chose to explore were the age wrestlers, years of experience, and the age at which the wrestlers won their first medal at the European Championship. The researchers utilized statistical analysis to determine what the average was for each of the factors within each weight category among 180 European wrestlers. The researchers gathered the data throughout multiple years to determine trends as the sport evolved. This information provided valuable insight to determine trends for what age and maturity a wrestler would have to be at in order to reach their peak performance in their chosen weight class. A limitation to this study is that it focused only on international style wrestling. In America, Amateur wrestling is primarily dominated by Scholastic or Folk style wrestling. Also NCAA primarily focuses on students aged 18-23 because it is a collegiate sport; therefore, the idea of age is less of a factor in the American style.

However, this study provided valuable insight to separating factors of winning by weight classes or even categories of weight classes (lightweights, middleweights, and heavyweights). Also years of experience required by a wrestler to win an NCAA title would be an interesting adaptation to this study.

Similarly, Farwell (2013) proposed a study to statistically examine anecdotal predictors of wrestling success and how they actually related to winning a match. He measured several predictors of wrestling success including scoring first in the match, achieving riding time bonus, getting near fall points, scoring on the edge of the mat and leading in the second and third periods in 16 collegiate wrestlers from one NCAA Division III program. The wrestler being measured was evaluated through film to see if he accomplished any of the predictors and then compared to his success in the match. This was able to statistically prove the efficacy of the anecdotal predictors of wrestling success. This study is the most relative to the proposed research. The biggest limitation of this study is the small sample size. With only 15 wrestlers, all from the same school, it is difficult to make statements as to the efficacy of certain scoring strategies. Some schools may put more emphasis on certain scoring strategies than others and therefore receive more success from those strategies. Because of this, a greater emphasis needs to be made on diversifying the sample size. Also, it would be impactful to study different weights or weight ranges because styles tend to change among the different weight classes.

Massidda and Calò (2012) researched the relationship between individual gymnastic event performance and overall performance within the competition. Their findings supported their hypothesis that certain events have more of an influence on the

athletes overall score during both the qualification and final phases of competition. They showed this by analyzing the different events for both men and women during both the qualifying and final phases of competition. Then the event scores were compared with the overall performance scores to see what events the most successful gymnasts excelled at. This idea explores what areas the more successful athletes in that sport are excelling in. This research shows us how to compare small parts of a competition for an individual with the individuals overall performance. In the same way the wrestler's performance in certain factors will be analyzed and compared with their success in the match.

Measuring Scoring Areas

Although there has been little research in the sport of wrestling on effective scoring strategies, there is quite a bit of literature regarding scoring strategies from other sports. One of the best representatives of scoring strategies that have been studied is that of position. For most sports studied this has to do with field position.

The free kick position has been studied in depth to find the most effective positions for scoring on a free kick (Alcock, 2010). The free kicks from 32 games in the 2007 Women's World Cup were analyzed to find whether distance and location have an impact on the scoring outcome of the free kick. They found that there was indeed a correlation and that all of the free kicks scored were within 7 meters of the penalty circle.

Another analysis on women's soccer took a more active approach in the success of scoring strategies (Mara, Wheeler, & Lyons, 2012). This study measured the success of attack plays in the women's league of Australia during the 2010 and 2011 seasons. It was found that cross kicks and corner kicks had the most success in setting up a successful scoring opportunity.

Ruiz-Ruiz et al. (2013) also examined field position in soccer during the 2006 World Cup. While studying the 64 games that took place, the amount of entries into the penalty box was recorded for both the winning and losing teams. It was found that the winning team entered the losing team's penalty box more often and allowed the losing team in their own penalty box less often. This study shows the importance of field position for winning a soccer match. In wrestling this can be related to mat dominance. A common theory is that the wrestler who tends to dominate the mat is generally the most successful. Mat dominance is generally defined as keeping one's back to the center of the mat and one's opponent between them and the out of bounds line.

More analysis on the impact of field position in scoring was done regarding where the possession was obtained (Mahony, Wheeler, & Lyons, 2012). This study analyzed the 2011 Men's Asian Cup finals. It found that more goals were scored when possession was obtained in the team's attacking half of the field rather than the defending half.

Mirvić et al. (2015) conducted similar research in the game of water polo. The study utilized 45 matches from the 2011 Women's World Water Polo Championships to find the correlation between successful goals and the location of shots on goal, penalty shots, and amount of shot attempts. The findings showed that each of these variables had an impact on the amount of successful goals and the outcome of the match.

All of these research examples show how important position on the playing surface is for successful scoring attempts. This research can be extended to the sport of wrestling. One of the popular anecdotal theories in wrestling is the importance of scoring on the edge of the mat. Many coaches and wrestlers believe that the most effective place to score a takedown is on the edge of the mat rather than the middle because it limits the

opponent's area to defend. It would be important to study the amount of points scored on the edge of the mat compared to the amount scored within the circle, and, to take it further, whether scoring on the edge of the mat has an impact on match success.

Measuring Dominant Strategies within the Match

Another well-documented strategy for success that is found in sports is dominance or advantage within the competition. This can take many forms, but the aggressor in the game or match usually marks it. It is usually measured within sports by time of ball possession, time spent in the other team's zone, pace, and scoring first. Most athletes and coaches believe these to be indicators of success within the competition. However, many teams train to compete in a more passive way that allows them to conserve energy by only attacking when the opportunity presents itself, rather than being in a constant state of attack. These studies explore the effectiveness of certain dominating strategies.

An analysis of possession strategies was done on the sport of basketball in boys aged 16 and younger (Ortega et al., 2007). The purpose of this study was to study the techniques utilized during winning and losing team's possessions during games. The variables included fast breaks, set offenses, time of ball possession, passes, and participating players. This allowed the authors to see what techniques more successful teams in that age division excelled in. The results showed that the winning teams tended to possess the ball for shorter periods and passed more than the losing teams. The assumed reason that winning teams spend less time in possession of the ball is that they dominate the match and therefore need less possession time to bring the match to a draw or win. In relation to wrestling, this brings the idea of time to light. An important factor

to explore would be the effect of scoring at the beginning and end of the match. Scoring at the end of a period (15 seconds or less left) would be beneficial because it would provide the scoring wrestler with unanswerable points.

Scoring at the beginning would also be a good factor to explore because it would create less stress on the scoring wrestler because they would get the lead and have less pressure to score again. This concept is explored in the sport of baseball (Courneya, 1990). 10 NCAA teams were analyzed to find the impact of game location and scoring first in competition. It was shown that both being on a home field and scoring first correlated strongly to winning. Because wrestling tournaments often provide the participants in individual competition with neutral ground, the location is of little impact. However, scoring first has been one of the most popular anecdotal factors for success in wrestling for many years. The thought behind this theory is mostly thought to be psychological because it puts the non-scoring wrestler in a deficit where they not only have to score to even the score but also have to score again to get ahead.

Mahony et al. (2012) also observed tactics regarding possession for the winning team. The study sought to analyze the different attacking styles found in soccer. Direct style dealt with fast attacks with minimal passing and indirect dealt with slow attacks with lots of passing. It was discovered that direct attacks led to the most success because it minimized chances for the ball to be turned over. This could be interpreted very interestingly in the terms of wrestling. In wrestling there are styles of attack that appear direct such as tying up and hand fighting to get to a shot. Also there are styles that appear much more indirect. The indirect style can be interpreted as more “open” and reactive to

the opponent; it deals very little with hand fighting with the opponent before attempting to score.

Ruiz-Ruiz et al. (2013) also explored the effects of ball possession on winning. Possession is important because it establishes one team as the offender and one as the defender. The study concluded that it is important to be in possession often and therefore be the offender because it gives the most opportunities to score. However, it also mentioned that the losing team often had more possession time because they did not use it as efficiently. The idea of possession time is very similar to that of riding time or advantage time in wrestling. When the two wrestlers are on the mat, a clock is run to mark the top wrestlers time in the advantaged position. At the end of the match, if one wrestler has a minute more than the other on his clock, he gets an extra point. Achieving a "riding time" point generally shows that one wrestler dominated the match when it was down on the mat, but has no bearing on how the match went when the wrestlers were in the neutral position. Because of this, it would be interesting to find the amount of matches where the winner also has riding time. This would help further the knowledge of which positions are the most important for coaches to work on.

Ruiz-Ruiz et al. (2013) also showed the importance of field position when they found that the winners of soccer matches get into their opponents penalty box more than the loser's get in theirs. However, this also shows the importance of creating scoring opportunities. By being in the opponent's penalty box, soccer players present themselves with opportunities to score.

Shots on goal is another way to measure scoring opportunities as factors for success. In ice hockey, statistical significance is found between winning and losing

teams shots on goal (Huntata & Zapletalová, 2012). This study focused on game statistics from the 2010 Winter Olympics. One of the big theories for wrestling is the need to take lots of attempts at shots because the more attempts you take, the more tired the opponent gets and the more chances you have to score. This research opens another factor that should be explored: the impact of shot attempts on winning a match.

Measuring Penalties

Many factors effect success in athletic competition. In order to promote fair and entertaining play, rules have become a part of every sport and effect how they are played. Because of this, it is important to analyze how much penalties may correlate with contest outcomes.

When revisiting Mirvic et al. (2011) we discover how important the penalty shot is in water polo. Scoring on penalty shots had a positive, significant correlation with winning the match. Similarly Alcock (2007) measured the success of free kicks on location in soccer. This can be extrapolated to most sports by pointing that a penalty shot is important to score because it is an automatic score attempt with minimal obstacles. The more obstacles are minimized the better chance one has of scoring.

Huntata & Zapletalová (2012) showed that the winning teams in the 2010 Olympic Games for Ice Hockey spent more time in power play than the losing team. Not only did they spend more time in power play, but they also scored more points when given the power play opportunity. This would indicate that a penalty to an athlete's opponent might significantly increase that athlete's chance at winning.

Wrestling does not have a penalty shot, free shot, or power play, but there are many other penalties that can work in favor of the opposing wrestler. For instance, a

wrestler is allowed 1 stalling warning before the next one gives up a point. So if a wrestler can force his opponent to stall perhaps because he is able to tire him out, then he can earn extra points. Another common penalty that can result in points for the opponent are cautions. Cautions are given for false starting technique or starting the action of wrestling before the referee blows his whistle. A point is awarded to the opposing wrestler after the third caution. If a wrestler can earn points over his opponent from penalties, he may have a statistically significant chance of winning the match.

Summary, Conclusion, and Recommendations for Future Research

The sport of wrestling has not only been around in hundreds of forms amongst all cultures and throughout history, but it also continues to grow in its modern form (Destani et al., 2014). This longstanding history and tradition has lent itself to many theories on the best scoring strategies and practices. However, most of the wrestling literature focuses on training and injury prevention strategies. Research began with factors that may contribute to success in wrestling such as age and experience and how those factors are different within weight classes (Baić et al., 2014). However, there is still a lack of extensive research on the technical side of wrestling. Farwell (2013) laid the groundwork for researching the technical aspect by introducing a method of doing it, but small sample size and new rule changes have led to very narrow implications for his findings. There are many other instances of sports using a coding system to determine the efficacy of certain factor's influence on winning or scoring in that sport such as in gymnastics where individual event's impact on the overall score in the competition were measured (Massidda & Calò, 2012). By utilizing these types of methods, wrestling strategies could also be better understood, and therefore, better coached.

The factor for sport outcome that seems to have been studied the most is that of positions within the sporting arena. (Mirvić et al., 2015) and Alcock (2010) both explored the importance of position for success in penalty shots in water polo and soccer respectively. Soccer position was also studied for places on the field that result in the most scoring plays (Mara et al., 2012) as well as the winning team's control on the field (Ruiz-Ruiz et al., 2013). These studies that show how important position of the playing arena is, can be carried over to the sport of wrestling by examining the importance of scoring points on the edges of the mat and whether the winning wrestler tends to maintain mat control by keeping his opponent on the edge of the mat.

Other factors that effect scoring in athletic competitions involve the dominant strategies of one team over the other. For instance Ortega et al. (2007) and Ruiz-Ruiz et al. (2013) both analyzed ball possession in basketball and soccer respectively and found that many possessions are important for scoring but that it is important to use the possession efficiently to make a score attempt right away. Courneya (1990) showed the importance of scoring first in baseball, something that has long been preached in wrestling. Not only does scoring first have an impact on sporting outcomes, but also making many scoring attempts greatly increases ones chances at winning (Huntata & Zapletalová, 2012).

Extrapolating this literature to the sport of wrestling opens up many possibilities for predictors of wrestling matches. Because wrestling is a sport of control and position, most of these predictors have to do with controlling the match. Scoring first is important because it sets the mental precedence for the rest of the match. Similarly it would be beneficial to know whether scoring at the end or beginning of periods makes a significant

difference to the outcome of the match. Also taking many shot attempts, not only increases the opportunities one has to score a takedown, but also fatigues the opponent to increase the chance of scoring again. Using the riding time clock is very similar to having possession in other sports. Being on top gives the best chance for big point moves, but the most successful wrestlers should be able to use the time efficiently to score multiple times, similar to possession for basketball and soccer. Finally, this research brings up the styles of neutral wrestling (open and reactive or closed and direct) and which one leads to more takedowns.

Another factor that would affect the outcome of a sport would be that of penalties. Penalties ensure that the competition is played the way it was intended. Penalties are present in every sport and manifest themselves in different ways. Some penalties cost the offender more than others. The penalty shot is such a big factor in water polo and soccer that both (Mirvić et al., 2015) and Alcock (2007) focused a large part of their studies on the effectiveness of different locations of the penalty shot. Huntata & Zapletalová (2012) also measured the advantage that a penalty brings to a team with the power play in ice hockey. It would make sense that a similar impact would be present in the sport of wrestling where the penalty of committing some infractions are a guaranteed point for the opponent, rather than just a chance to score.

There is a respectable amount of literature regarding predictors of success in many sports, especially team sports. Wrestling, however, with all its age and history, has little research in regards to what strategies can be predictors to success in the sport. What little there is either doesn't focus on the same style or has a very narrow scope of implications.

As a result more research is needed that answers the question, what predictors are there for winning a collegiate wrestling match? This research can be based off of previous anecdotal theories that have lingered in the wrestling rooms throughout the decades, but should primarily have basis in other sports predictive factors. When adapted for wrestling, these factors from other scientific literature are scoring points on the edges of the mat maintaining mat control, scoring first, scoring at the end or beginning of periods, shot attempts, riding time, neutral wrestling style, stalling warnings, and cautions. Each of these factors can be statistically analyzed to answer whether they have significant influence over the outcome of the match. Finally a solid sample should be collected from several schools to allow for variations in technical styles and training styles. This research would be further made better by answering which of these factors have the most influence within the four different weight categories: lightweights (125, 133, and 141), middleweights (149, 157, and 165), high weights (174,184, and 197), and finally heavyweights (285).

This research would provide valuable insight into the strategies and technicalities within the sport of wrestling. Not only would it provide coaches solid, research findings to build their programs from, but it would also help in the creation of future rules to make the sport of wrestling more competitive and entertaining. Future research to build off of this would focus on dividing up the weight classes even further so that each of the ten weight classes are analyzed individually. Also it would benefit wrestling at the international level to incorporate all of these factors into the international styles of Greco-Roman and Freestyle wrestling.

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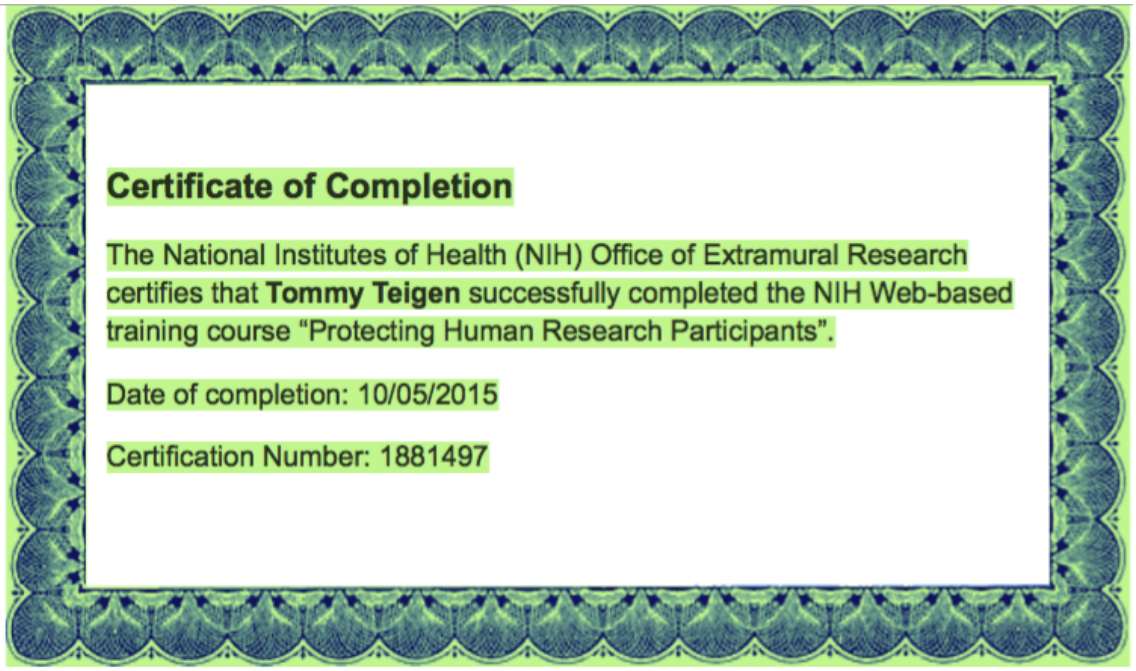
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APPENDIX B

HUMAN SUBJECT RESEARCH TRAINING CERTIFICATE



Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Tommy Teigen** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 10/05/2015

Certification Number: 1881497

APPENDIX C

CODING TOOL

Coding Tool

Key

T- Takedown

FT- First Takedown

A-Shot Attempts

SE-scoring on the edge of the mat

N2 or N4-Near Fall points

SL-Scoring Last in a Period

S-Stalling

S1- Stalling point awarded

15 sec	1st Period	15 sec	15 sec	2nd Period	15 sec	15 sec	3rd Period	15 sec

*If needed

15 sec	1min Overtime	15 sec			15 sec	1min Overtime	15 sec
15 sec	30sec	15 sec			15 sec	30 sec	15 sec
15 sec	30 sec	15 sec			15 sec	30 sec	15 sec

First takedown in the match: Y or N

Number of T:

Number of shot attempts:

Number of time SE:

Number of NF:

NF2:

NF4:

Number of times scored in the first or last 15 seconds:

Stall warning/points:

Number of periods with last score:

Points in 3rd period:

Riding Time: Y or N

Mat Control: Y or N