# WHAT ARE THE ODDS? A PRELIMINARY TEST OF A THEORETICAL MODEL OF SPORTS TEAM EFFECTIVENESS

by

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# ABSTRACT

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This study served as a preliminary test of the Sports Team Effectiveness (STE) Model developed by Devine, Lindsey, and Wolfarth in 2017. The purpose of this study was to examine the extent to which several variables help explain winning in professional basketball. The value of the STE model in predicting the winner of basketball games was compared to already-existing predictors of winning. Archival data from 435 games from the 2016-2017 season of the National Basketball Association (NBA) were examined. Bivariate correlations between each antecedent of team effectiveness and team effectiveness were computed. Secondly, multiple logistic regression was used to examine the extent to which the antecedents predict winning while controlling for the other antecedents. Finally, hierarchical logistic regression was used to examine the extent to which the STE model can predict the winner of the game above and beyond game location and opposition quality. The variables of game location, opposition quality, role performance, and number of contested shots taken by the opposing team were significantly related to winning. Overall, the STE model did significantly reduce model error above and beyond game location and opposition quality, giving empirical support to the theoretical model.

# INTRODUCTION

Sports teams are pervasive and incredibly important in our society. In a recent Gallup poll, 59 percent of Americans identified as sports fans, which is a trend that has continued since Gallup began conducting this poll in 2000 (Jones, 2015). Tens of millions of people tune in to watch professional football each week, and 26 of the top 27 programs on TV in 2015 were professional football games (Chase, 2015). Sports also have a huge impact on society outside of professional sports. There are nearly eight million high school athletes and 460,000 college athletes in the United States alone (NFHS, 2014; NCAA, 2017). Finally, the Harvard School of Public Health conducted a poll in 2015 and found that a quarter of the adults in the United States participate in sports (Blendon, Benson, Sayde, & Gorski, 2015).

Team sports is a big business, and the financial success of sports teams depends heavily on their ability to win. According to Badenhausen (2017), the average team in the NBA is now worth $1.36 billion, which represents a 3.5-fold increase over the last five years. Professional athletes are some of the highest paid people in the United States. In 2014, the average player's salary in the National Basketball Association (NBA) was $4.58 million, which is the highest average salary out of any sports league in the world (Gaines, 2015). Just 448 NBA players collectively earned over $2 billion in the 2014-2015 season. These incredibly high salaries suggest that fans and corporate sponsors support the teams and are willing to invest money in the sports organizations. These salaries also suggest that many people see these athletes as celebrities and role models. Undoubtedly, many younger athletes look up to these professional teams and superstars and draw inspiration from them. It is virtually impossible to walk through a city without seeing someone wearing a sports jersey or shirt supporting his or her favorite team. These fans want to support teams that perform well and win championships, and sponsors likely want to associate their brand or product with a successful team. This support is evidenced by the salaries the players earn and by how much the teams are worth.

Many sports organizations extensively track player and team performance. Each sport has its own unique game-related variables that are tracked for each game. Many of these variables are important to consider when considering the likelihood that a particular team will win a given game (e.g. game location, fan support, opposition quality, game management, role performance, and teamwork). Some of these variables have been studied quite frequently while some have hardly been studied at all.

The main contribution of this paper is to empirically test the Sports Team Effectiveness (STE) theoretical model developed by Devine, Lindsey, and Wolfarth (2017). This paper will be one of the first to test the effects of several understudied antecedents of wining including teamwork and game management. Furthermore, this paper will help advance the theory behind the STE model by showing the extent to which the antecedents can predict winning. The results can help provide practical implications for sports teams as well. By showing which antecedents are most important, teams can focus their efforts towards improving specific aspects of the team.

The next section will include a high-level summary of the Input-Process-Output (IPO) model developed by McGrath in 1964 and a review of the sports team effectiveness literature framed around the STE model. The goal of this paper is to provide a preliminary empirical test for the STE model. The main research question this paper will address is as follows:

Does the STE model have value in explaining winning in team sports above and beyond existing predictors?

# LITERATURE REVIEW

## Input-Process-Output Framework

In 1964, McGrath created a well-known framework for organizing the research on how a group functions called the Input-Process-Output model, or the IPO model. This model has been highly influential and has had a substantial impact on the last 50 years of team effectiveness research (Kozlowski & Ilgen, 2006). This framework posits that various inputs such as features of the group, its task, and its work context, affect group-interaction processes, which in turn affect the group's output. The *inputs* refer to the characteristics and resources of the team that originate from three different levels (Kozlowski & Ilgen, 2006). The individual level describes the characteristics of the individual members, the group level describes the structure and characteristics of the team as a whole, and the environmental level describes the context in which the group operates (Hackman, 1987). The *processes* refer to the tasks in which the individuals engage and how these individuals combine their skills and resources to accomplish the task (Kozlowski & Ilgen, 2006). The *outputs* involve the performance of the team, the satisfaction of team members' needs, and the willingness of team members to stay on the team (Kozlowski & Ilgen, 2006). Differences in team performance can therefore be explained by examining the differences among two or more teams' inputs and interaction processes.

The IPO model has sparked a lot of research and has been expanded and developed by researchers over time. Nearly all team effectiveness models developed after the IPO model use the input-process-output structure as their foundation (Byrne, 2015). One of these models includes Gladstein's (1984) model of team effectiveness. This model states that group-level and organization-level variables are expected to directly influence team effectiveness. Group interaction processes should also impact team effectiveness, but this relationship is expected to be moderated by the complexity of the group task. As tasks become more interdependent, group interaction processes are expected to have more of an impact on team effectiveness. Another model based on the IPO model includes Hackman's model of team effectiveness developed in 1987. This model states that group-level and organization-level variables are expected to impact team processes, and this relationship should be moderated by group synergy. When group members use their energy and talents well, the input variables are expected to more strongly impact the group processes. Team processes are then expected to impact team effectiveness, and this relationship is thought to be moderated by material resources. As the number of available resources increases, team processes are expected to have more of an impact on team effectiveness. Research continues to use the IPO model as a basic framework for testing theories and drawing important theoretical and practical conclusions.

Although the IPO model provides a lens through which team performance can be examined and understood, its utility as a practical tool for any particular type of team is limited due to its broad scope. This model was meant to be applicable to many different kinds of teams; it was not meant to be overly specific to a certain type of team. The IPO model is useful as a broad model and can serve as a foundation for developing a more specific model that focuses on a particular type of team. The following section introduces the STE model, which is based on the structure of the IPO model.

## The STE Model

The STE model is a theoretical model that is intended to address the effectiveness of sports teams consisting of three or more individuals. This theoretical model is specific to team sports, but at the same time it remains general enough so that it can be applied to all team sports.

There are three levels of variables in this theoretical model, similar to the IPO model. First, *individual-level* variables are variables that involve the characteristics of the individuals on the team. Second, *team-level* variables include characteristics of the team currently out on the field or court. Third, *contextual-level* variables are variables that are expected to impact the team but are not directly related to the behaviors of the players or coach. As seen in Figure 1, the top half of the model depicts the team-level variables in red while the bottom-half depicts the individual-level variables in green. Two moderating variables are depicted in yellow. Finally, contextual-level variables are depicted in purple and are placed above the model, signifying that they can have an impact in various ways on team effectiveness. This model focuses mainly on individual- and team-level variables but also includes several contextual variables that are expected to have an important relationship with team effectiveness.

The main outcome variable in this model is *team effectiveness*, which is operationalized as winning across a season. Team effectiveness is the final variable of a chain of several individual- and team-level variables connected serially to one another. There are three proximal antecedents of team effectiveness, the first of which is *game management.* Game management refers to the game-related decisions the coaching staff makes during the game related to optimizing the team's strategy. These decisions include changing the player lineup, calling plays, and developing short-term team goals. All of these game-related decisions happen during a game. The second proximal antecedent of team effectiveness is *teamwork*. Prior researchers have defined teamwork as overt behaviors and verbal statements displayed during interactions between team members that promote successful collective action (Morgan, Salas, & Glickman, 1993). Teamwork can be defined in sports as the real-time coordination of team members during a game (Devine et al., 2017). Team members must communicate during the game and align their behaviors in time and space in order to complete game-related objectives associated with winning. The final proximal antecedent of team effectiveness is *role performance*. This is an individual-level variable that refers to how well an individual performs functions attached to his or her role on the team. These functions can be considered as taskwork behaviors, which refer to behaviors done by an individual that do not rely on multiple people to execute (Eccles & Tenenbaum, 2004). The team is expected to have a better chance of winning when the players play well within their specified position.

*Sport interdependence* is also expected to moderate the relationship between role performance and team effectiveness as well as the relationship between teamwork and team effectiveness. Interdependence refers to the manner in which team members exchange information in order to accomplish a task (Saavedra, Earley, & Van Dyne, 1993). As the level of interdependence increases, the relationship between role performance and team effectiveness is expected to decrease. Highly interdependent sports require the team members to act as a unit rather than to act individually. Team effectiveness is therefore influenced less by the average performance of all players on the team and more by the collective performance of the team as a whole. Therefore, as the level of interdependence increases, the relationship between teamwork and team effectiveness is expected to increase.

Role performance is the main outcome variable at the individual level in the model. It is expected to be influenced by *player effort* as well as by *player skill*. Player effort refers to players' physical and mental exertion exhibited during a game. Players who exert more effort will likely perform better than those who exert less effort. Player skill refers to the degree to which individuals can execute the behaviors associated with their roles. For example, point guards in basketball are expected to be able to dribble the ball well. Highly skilled point guards will be able to handle the ball and move around the court fluidly and with precision. Players who are more skillful are likely to perform better in their roles. The relationship between player skill and role performance is expected to be moderated by player effort and by *player health* such that as player effort or health increases, player skill will have a stronger effect on role performance. Even if a player is highly skilled, that individual cannot perform optimally if he or she is sick or injured. Player skill is expected to positively influence *player role efficacy*. As player skill increases, player role efficacy, defined as the belief of the players that they can successfully perform their assigned roles during a game, is expected to increase. As a player's role efficacy increases, that player will likely exert more effort in a game.

Finally, player attitudes towards the team and towards the idea of winning should influence player role efficacy. Attitudes toward the team reflect the extent to which a player identifies and cares about the team. Attitudes towards winning reflect the extent to which a player desires to win and to avoid losing. Players who have positive attitudes towards the team and who desire to win will likely believe that they can perform well in their role. Some individuals may only be concerned with performing well as an individual, which would likely undermine several teamwork processes. Similarly, some individuals may not care about winning the game, which may have a negative impact on the team as a whole.

In the STE model, player attitudes and player role efficacy are both expected to have cross-level effects, connecting the individual-level variables to the team-level variables. Player attitudes are also expected to positively influence *cohesion*, which is a team-level variable. Team cohesion is defined as "a dynamic process that is reflected in the tendency of a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs," (Carron, Brawley, & Widmeyer, 1998). A meta-analysis on the relationship between cohesion and team performance in sports found that, on average, individual studies reported a correlation of r=.655, suggesting a strong relationship between the two variables (Carron, Colman, Wheeler, & Stevens, 2002). Cohesion is also expected to be influenced by *demographic faultlines*. Differences in surface-level demographic characteristics, such as gender, race, or age, can lead to demographic faultlines, which are hypothetical dividing lines that split a group into subgroups (Lau and Murnighan, 1998). Faultlines can vary in strength; as the number of individual attributes align to create distinct subgroups, the strength of the faultline is expected to increase. Cohesion is expected to positively influence *collective efficacy*, which is also expected to be positively influenced by player role efficacy. In 1982, Bandura defined collective efficacy as a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments. In other words, collective efficacy refers to how much a team believes they can perform some task well. A meta-analysis showed that the average correlation between collective efficacy and group performance was r=.37 (Stajkovic, Lee, & Nyberg, 2009). Collective-efficacy is expected to be an antecedent of teamwork.

The last portion of the model deals with the skill of the coaching staff. *Coaching skill* predicts *game preparation, practice quality*, as well as collective efficacy. Coaching skill refers to how well the coaches can execute behaviors involving planning game strategies, providing feedback, and developing and inspiring the players. Game preparation refers to the quantity and quality of effort expended by the coaching staff to prepare the team for a game. This includes several behaviors such as managing team practice sessions, watching film of the upcoming opposing team, researching strategies, and optimizing lineups. As the skill of the coaching staff increases, the quality of game preparation is expected to increase. Practice quality refers to how relevant and effective the activities performed during practice are for improving player skill and teamwork. Practice quality is expected to be positively related to teamwork. Game preparation is expected to be positively related to game management.

There are several contextual variables that do not have direct links in the STE model but are thought to have an impact on the team. The amount of *financial resources* a team has is expected to impact how much money can be devoted to team salaries, equipment, trainers, medical staff, etc. *Fan support* refers to how interested the fans are in the team and how much support the people in the surrounding community give to the team. O*pposition quality* refers to the skill of the opposing team. Higher-quality teams are better at their sport; these teams likely consist of superior athletes and have a more-refined game-related strategy. Finally, *game location* refers to where the game is played; a team can play in its home venue, at another team's home venue, or at a neutral location.

In summary, this theoretical model explains how four exogenous variables (coaching skill, demographic faultlines, player skill, and player attitudes) impact team effectiveness through several mediating and moderating variables. The mediating pathway at the team level includes the variables of game preparation, practice quality, game management, cohesion, collective efficacy, and teamwork. The mediating pathway at the individual level includes the variables of player role efficacy, player effort, player skill, and role performance. Sport interdependence is expected to moderate the relationship between teamwork and team effectiveness and between role performance and team effectiveness. Player health is expected to moderate the relationship between player skill and role performance. There are also several contextual variables including financial resources, fan support, game location, and opposition quality that are expected to impact the team but are not directly related to the behaviors of the players or coaching staff.

For the purpose of this research project, the primary variables of concern are the three proximal antecedents of team effectiveness–game management, teamwork, and role performance, plus the contextual variables of game location, fan support, and opposition quality. Because the data for this project will be at the game level rather than the season level, it is important to include game location, fan support, and opposition quality as antecedents. They are important variables to consider at the game level because prior research has found that these variables can significantly impact team effectiveness. This research will be highlighted in a following section.

These variables were chosen because they are expected to be directly related to team effectiveness. Additionally, they are expected to be the most important direct effects of team effectiveness as proposed by the STE model. The conceptual model for this project can be seen in Figure 2. This conceptual model is a partial version of the model depicted in Figure 1. These two models are not different; the model in Figure 2 was included to make it easier to see the focal variables for this project. In the model in Figure 2, the contextual variables are depicted in grey, the team-level variables are depicted in red, and the individual-level variable is depicted in green. The following section will highlight research on the focal variables for this project as well as provide hypotheses.

## Theory and Research on Sports Team Effectiveness

### Game Location

Home field advantage was defined by Courneya and Carron (1992) as "the consistent finding that home teams (i.e. teams playing in their own venue as opposed to the opposing team's venue) in sports competitions win over 50 percent of the games played under a balanced home and away schedule." This phenomenon is well documented, and a recent meta-analytic review has shown that home teams will win 60.4 percent of all athletic contests (Jamieson, 2010). This is an impressive finding considering that this analysis did not consider any variables other than game location that would influence team effectiveness. In this study, the researcher included a total of 87 effect sizes involving 34 individual studies. These studies involved a variety of sports including baseball, football, hockey, soccer, basketball, etc. and included data from before 1950 to the year 2007.

There were several significant moderating variables that emerged in this meta-analysis. However, the effect size did not differ drastically from the overall main effect of .604. For example, soccer teams playing at home won 67.4 percent of games; this was the largest difference in win probability from the baseline of 60.4 percent. Basketball teams won 62.9 percent of games played at home. All of the significant moderating variables had effect sizes around .60, which suggests that home field advantage is relatively stable across situations.

To explain the phenomenon of home field advantage, several researchers have developed the Standard Model, which describes the causal processes that connect game-location variables to home field advantage (Carron, Loughead, & Bray, 2005; Courneya & Carron, 1992; Schwarz & Barsky, 1977). This theoretical model states that audience support, travel fatigue, familiarity with the venue, and competition rules each impact the degree to which home field advantage occurs. These are all expected to impact the team's chance of winning. A team that travels to another venue may be tired from switching time zones, and the unfamiliar venue coupled with an unwelcoming crowd may have an adverse cognitive effect, which may then affect performance. Prior research has shown that audience support, operationalized as crowd size, crowd density, and crowd behavior, is related to the magnitude of home field advantage (Armatas & Pollard, 2013). This model asserts that the support of the audience can influence the decision-making of the officials such that the calls they make favor the home team (Downward & Jones, 2007).

However, home field advantage still persists even in the absence of an audience, which implies that variables other than audience support play a role in explaining home field advantage (Van de Ven, 2011). This finding suggests that the home team could be more familiar and comfortable with the home venue, which would make them more likely to win. Another part of the model states that the away teams may experience travel fatigue, which is expected to decrease their performance. Indeed, research has shown that home field advantage increases as much as 20 percent for each time zone the opposing team crosses (Goumas, 2013). These effects were more pronounced when teams travelled eastward (Recht, Lew, & Schwartz, 1995). In summary, the Standard Model suggests that four variables can impact home field advantage, and research suggests that this may be the case.

An alternative model developed by Neave and Wolfson (2003) called the Territoriality Model states that home field advantage is a manifestation of the natural protective response to territorial invasion by an enemy. Many animals experience testosterone spikes, which are associated with protecting home environments (Sobolewski, Brown, & Mitani, 2012; Jansen et al., 2011). This may provide a spike in awareness or energy. This model argues that humans experience this same phenomenon when playing an opposing team in their home environment. Research by Neave and Wolfson (2003) has shown that soccer players had higher testosterone levels before home games as compared to away games. Additionally, another study by Carré, Muir, Belanger, and Putnam (2006) found that testosterone levels decreased during away games as opposed to rising for home games.

Regardless of the exact cause of home field advantage, it is a widely recognized phenomenon. Its consistent and reliable occurrence makes it a robust predictor of winning. I expect that teams playing at home will be more likely to win.

*Hypothesis 1: Teams playing at home will be more likely to win than teams playing away.*

**Fan Support**

Fan support refers to the level of interest and support for the home team. One can assume that most of the fans attending a game are rooting for the home team. Although fan support cannot be directly measured because there is no way of knowing exactly how many fans support each team, it should be directly proportional to crowd size. Previous literature suggests that crowd size may be related to the performance of the home teams. Russell (1983) collected data from 426 games in the Western Hockey League during the 1978-1979 season and examined how the size and density of the crowd affected team effectiveness and team aggression. He found that crowd size was negatively related to the aggression and performance of the visiting teams but was unrelated to that of the home teams. Similarly, Goumas (2013) studied major international club soccer leagues in four FIFA confederations in Europe, Asia, North America, and South America. He also found that home field advantage increased as crowd size increased. This research suggests that the size of the crowd interacts with the location of the game to pronounce the effect of home field advantage. Therefore, the team playing at home is expected to be more likely to win as crowd size increases.

*Hypothesis 2: There will be a positive bivariate relationship between crowd size and winning for teams playing at home.*

**Opposition Quality**

As previously mentioned, opposition quality refers to the skill of the opposing team. Higher-quality teams likely consist of superior athletes and have a more-refined game-related strategy. This is an important antecedent of focal team effectiveness because as the skill of the opposing team increases, the chances of the focal team winning a game should logically decrease.

Prior researchers have often assessed team quality as the percentage of games won during a season. Sampaio and colleagues assessed the effect of starting lineup, game location, and opposition quality on game quarter final score in Spanish professional basketball (Sampaio, Lago, Casais, & Leite, 2010). In order to assess opposition quality, they ranked the teams' winning percentages in descending order and calculated the ordinal difference between the rankings. As the difference between two team's end-of-season rankings increased, the team with the better record won more often. This was an especially impressive finding considering they controlled for starting quarter score and game location in their model. As the end-of-season ranking between two competing teams increased by one, there was on average a .29 point difference at the end of each quarter in favor of the team with the better winning percentage. Additional research examining opposition quality's effect in basketball found that stronger teams with a better winning percentage outperformed weaker teams in defensive rebounding, two-point field-goals, three-point field-goals, and passing (Sampaio, Drinkwater, & Leite, 2010).

Similar research has focused on identifying variables that discriminate winning teams from losing teams in the UEFA soccer championship in Europe. Lago-Peñas and colleagues conducted a discriminant analysis on 288 matches played between 2007-2010 and found that the variables distinguishing the winning teams from the losing or drawing teams were shots on goal, crosses, ball possession time, game location, and opposition quality (Lago- Peñas, Lago-Ballesteros, & Rey, 2011). These researchers calculated opposition quality the same way as Sampaio et al. (2010). It is clear from this line of research that the quality of sports teams is a significant predictor of game outcome. I expect there will be a negative relationship between the opposing team's winning percentage and the focal team winning a game.

*Hypothesis 3: There will be a negative bivariate relationship between the opponent's winning percentage and the focal team winning a game.*

**Game Management**

Game management refers to the game-related decisions the coaching staff makes during the game regarding player lineup, team strategy, and short-term team goals. These decisions are related to making strategic decisions based on how the focal team is playing and how the opposing team is playing. One way coaches can intervene in the game and strategize with their players is by taking a timeout. A timeout stops the game and gives the players a chance to take a short break and talk to their coach about strategy.

Prior research has examined the effect of timeouts in basketball and their effect on performance (Gomez, Jimenez, Navarro, Lago-Penas, & Sampaio, 2011). Gomez et al. (2011) examined the effect of 144 timeouts from 18 basketball games randomly selected from a European basketball championship held in 2007. Five ball possessions before and after each timeout were analyzed. The variables they extracted to analyze from these ball possessions were two- and three-point field-goals scored and free-throws made by both the focal and opposing team. From this they calculated offensive and defensive performance by dividing points scored (offensive performance) or points allowed (defensive performance) by number ball possessions. They found that offensive and defensive performance slightly improved in the five ball possessions after the coach took a timeout as compared to performance in the five ball possessions before the timeout. Another study examining the effect of timeouts on game performance in handball found similar findings; the performance of the focal team increased relative to the opposing team when the focal team's coach took a timeout (Prieto, Gomez, Volossovitch, & Sampaio, 2016). These findings suggest that the coach may be able to have an impact on team performance by strategizing with his or her team during a timeout.

Another way a coach can have an impact on team strategy is by substituting players in and out of the game in order to optimize the player lineup. This happens fairly often in some sports such as basketball and less often in some sports such as soccer. There is limited research on the effect substitutions have on team effectiveness, but there has been research that examines when soccer coaches decide to make a substitution (Corral, Barros, & Prieto-Rodriguez, 2008). Unlike in basketball, coaches in soccer can only make a maximum of three substitutions per game. Once a player is substituted out, that player cannot return the rest of the game. These substitutions must be made with great care, and the coach must have a specific strategy in mind when making the substitutions.

Corral et al. (2008) examined 676 substitutions that were made over the 380 matches played in the 2004-2005 season of the Spanish First Division soccer league. The researchers did not consider substitutions made in the first half because these were usually due to injuries rather than a strategical move by the coach. They found that teams that were winning in the second half made their first substitution significantly later than when they were losing. Additionally, they found substitutions were made significantly later in the game when the opposing team was a higher-quality team. This suggests that coaches take into consideration how their team is playing and how good the other team is when making substitutions in soccer.

There is no limit to how many substitutions a player can make in basketball, so they occur much more frequently than in soccer. In the NBA, a coach can substitute players when the clock is stopped due to a dead ball and when the clock stops after a team scores a basket. A dead ball may occur when it goes out of bounds, when a timeout is taken, or when there is a foul. Therefore, coaches in the NBA have many opportunities to observe their team's performance as well as the performance of the other team and substitute players strategically in order to create an optimal lineup. The number of unique five-man lineups that play in the game can serve as a proxy for the number of substitutions. There are many combinations of five players the coach could choose to send out onto the court. Coaches who can respond well to the strategy of the opposing team will likely utilize a greater number of unique lineups than coaches who do not respond as well. Therefore, I expect there to be a positive relationship between the number of unique five-man lineups of the focal team and the focal team winning a game.

*Hypothesis 4: There will be a positive bivariate relationship between the number of unique five-man lineups of the focal team and the focal team winning a game.*

**Role Performance**

Role performance in the STE model is defined as "the extent to which a player successfully executes the functions attached to his/her role on the team," (Devine et al., 2017). A key feature of role performance is that it refers to behaviors that are done independently; these behaviors can be considered as taskwork behaviors rather than teamwork behaviors. *Taskwork* was defined by Eccles and Tenenbaum (2004) as any task that is not related to the operation of other team members and does not require coordination. *Teamwork* on the other hand does involve tasks that involve multiple people, and thus coordination is required.

There are numerous studies that examined how player in-game behaviors impact winning (e.g. Gomez, Lorenzo, Barakat, Ortega, & Palao, 2008; Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008; Sampaio & Janeira, 2003; Ziv, Lidor, & Arnon, 2010; Choi, Kim, Lee, Suh, & So, 2015). Many but not all of these behaviors can be considered as role behaviors. In order for a behavior to represent a role behavior, it must reflect taskwork rather than teamwork. *Rebounds*, *steals, turnovers*, and *blocks* are common basketball statistics, but these are also examples of role behaviors. They are done independently and do not require the coordination of two or more members on the team. Assists, for example, is not a taskwork behavior because it involves coordination between two individuals.

An example of one of these studies would include the research of Choi and colleagues (2015). This study is interesting, but it exemplifies how researchers often study player game behaviors without any regard to theory. Choi et al. (2015) used multiple logistic regression to see which statistics were significantly associated with a team’s chance of winning a basketball game. These researchers analyzed 540 basketball games from the Korean Basketball League and identified which statistics for each position were significantly related to winning. Some of the statistics they considered included the number of blocks, assists, shot percentage, rebounds, turnovers, and fouls. The exact results of this study may be interesting, but they are not what are important. What is more important is to note the methodology of the study. Some of the statistics included in the analysis (e.g. shot percentage) were essentially outcome variables rather than predictor variables. Any variable related to scoring will inherently be predictive of winning because winning in basketball is directly related to shooting the ball and scoring. When predictor variables are selected haphazardly and without a theoretical foundation, this will negatively impact the quality of the results. This highlights the importance of carefully choosing statistics that are aligned with the theoretical definition of role performance.

Because basketball is a highly interdependent team sport, few role behaviors can truly be done in complete isolation. The behaviors of the other athletes on the court will influence individual behaviors to some extent. Even though rebounds, steals, turnovers, and blocks are not purely taskwork behaviors, they are done much more independently than teamwork behaviors in basketball, which will be explored more in a following section. Therefore, although this way of measuring role performance is not perfectly consistent with the theoretical definition, it is the best that can be done considering the highly interdependent nature of the sport.

There are five distinct positions in modern basketball, and each of these positions has a set of tasks for which they are responsible. Many of these tasks overlap among the different positions and are shared by all members of the team. To more fully understand how their tasks overlap, consider Crawford and Lepine's (2013) idea of a *taskwork network*, which refers to the set of ties between team members who are jointly involved with the same tasks. Stronger ties indicate that team members share many tasks while weaker ties indicate that team members have few tasks in common. Basketball team members have strong taskwork ties because they share many tasks with one another. Rebounds, steals, and blocks are expected to be done by everyone on the team if they are able to do so, and everyone on the team avoids making turnovers. This highlights the strong taskwork ties. Due to the strong taskwork ties in basketball, it is possible to aggregate individual player statistics associated with role behaviors into team-level variables without regard to the actual position that performed them. Therefore, I expect there to be a positive relationship between aggregated rebounds, steals, and blocks and the focal team winning a game; in basketball, it is beneficial to get more rebounds, steals, and blocks. I expect there to be a negative relationship between aggregated turnovers and the focal team winning a game; unlike rebounds, steals, and blocks, turnovers are adverse rather than beneficial.

*Hypothesis 5: There will be a positive bivariate relationship between aggregated measures of beneficial focal team role behaviors (rebounds, steals, and blocks) and the focal team winning a game.*

*Hypothesis 6: There will be a negative bivariate relationship between an aggregated measure of an adverse focal team role behavior (turnovers) and the focal team winning a game.*

**Teamwork**

Morgan, Salas, and Glickman (1993) defined teamwork as overt behaviors and verbal statements displayed during interactions between team members that ensure successful collective action; this definition has been largely cited by other scholars in the field. I would expand this definition to include implicit or non-verbal communication as well; teammates do not always have to explicitly say a message in order for other teammates to understand the meaning. Overall, teamwork involves synchronizing individual movements in time and space. Unlike taskwork, teamwork involves factors such as coordination, communication, and synchronization with the other members on the team (Hinsz, Tindale, & Vollrath, 1997), which have been regarded as important aspects of team performance (Fiore, Salas, & Cannon-Bowers, 2001). Virtually all team sports require some sort of teamwork behavior. The players and coaches must be able to quickly communicate an idea, and all members on the team must interpret the idea the same way. Players often have to coordinate their movements with other players in order to fulfill some game-related objective; these teamwork behaviors are often essential to win a game. Coordination in team tasks is important because it allows the individual members to accomplish something together that would be too difficult to do individually.

There has been relatively little research examining real-time teamwork behaviors in sports (Carron & Hausenblas, 1998; Eccles & Tenenbaum, 2004). However, there are some studies that examine how passing the ball impacts team effectiveness. Passing the ball is an important part of many sports, and because it involves the coordination of more than one person to execute, it can be considered a teamwork behavior. Sampaio, Drinkwater, and Leite (2010) examined how several variables, including passing, differed among strong, intermediate, and weak teams in the 2007-2008 regular season of the Spanish professional basketball league. They classified teams into these three categories by considering their winning percentage, number of points scored, and number of points allowed. They then collected game-related data including the number of rebounds, field goals, errors, and passes. Stronger teams passed the ball significantly more than intermediate or weaker teams. Similarly, Vinson and Peters (2016) found that relegated field hockey teams made significantly fewer passes than mid-table and qualifying teams in four out of five outfield positions, supporting the notion that successful teams may tend to pass the ball more than unsuccessful teams. Like passing, many other teamwork behaviors are likely related to winning. I expect there to be a positive relationship between an aggregate measure of focal team teamwork behaviors and the focal team winning a game. These aggregate measures involve combining all individual occurrences of some teamwork behavior into one team-level variable. One variable within this aggregation, the number of field goals attempted by the opposing team in the paint, will be reversed scored because it is actually expected to be negatively related to winning. Basketball teams generally try to limit the number of field goals the opposing team attempts in the paint. Therefore, this variable will be reverse scored when entered as an aggregate.

*Hypothesis 7: There will be a positive bivariate relationship between the following measures of focal team teamwork behaviors and the focal team winning a game:*

a) *number of passes made by the focal team*
b) *number of uncontested shots taken by the focal team*
c) *number of contested shots taken by the opposing team*

*There will be a negative bivariate relationship between the number of shots attempted in the paint by the opposing team and the focal team winning the game.*

**Utility of the STE Model**

The previously mentioned variables should have incremental value in explaining winning when controlling for the other variables in the model. All of the direct antecedents of team effectiveness in the STE model are expected to explain winning from a unique theoretical perspective; they capture unique winning-related behaviors the others do not. As stated by the STE model, there are several levels through which winning can be explained. The variables mentioned thus far explore each of these levels and should therefore have incremental value in explaining winning when controlling for one another. Statistically, they should have a unique contribution to the statistical model because they are theorized to combine additively.

The STE model implies that all of the previously mentioned antecedents capture distinguishable winning-related behavior, suggesting that they have unique value in explaining winning. Therefore, the focal variables should have a significant relationship with winning when controlling for the other variables. The direction of the expected relationship appears in parentheses after each variable with a plus sign indicating a positive relationship and a minus sign indicating a negative relationship.

*Hypothesis 8: The following will have a significant relationship with winning when controlling for the other variables:*

*a.) Game location (+)*
*b.) Fan support (+)*
*c.) Opposition quality (-)*
*d.) Game management (+)*
*e.) Rebounds (+)*
*f.) Blocks (+)*
*g.) Steals (+)*
*h.) Turnovers (-)*
*i.) Number of passes made by the focal team (+)*
*j.) Number of uncontested shots taken by the focal team (+)*
*k.) Number of shots attempted in the paint by the opposing team (-)*
*l.) Number of contested shots taken by the opposing team (+)*

Because game location and opposition quality can consistently predict which team will win a game, they will serve as a baseline for predicting game outcome. In order for the STE model to have practical and theoretical utility, the other variables in the model must be able to explain winning more than home field advantage and opposition quality already do. The meta-analysis examining the relationship between game location and winning mentioned previously found that home teams win 60.4 percent of games, suggesting that this one variable alone can predict which team will win a game above chance levels. Prior research has also found that opposition quality can predict game outcome when controlling for game location, suggesting that it may be a robust predictor (Sampaio et al., 2010). Furthermore, more skillful teams are just expected to win more often than less-skillful teams.

After entering game location and opposition quality at step one of the statistical model, all other variables will be entered at the second step. The model error should decrease significantly between the first and second step. This will test whether the STE model can explain winning better than game location and opposition quality. Controlling for game location and opposition quality, I expect the remaining STE predictors as a set will significantly improve the model.

*Hypothesis 9: The focal STE predictors will result in significant model improvement compared to just game location and opposition quality.*

In summary, measures of the direct antecedents of team effectiveness specified in the STE model should be significantly related to winning in bivariate form. Additionally, they should collectively have unique value in explaining game outcome when controlling for each other. Finally, when entered at a separate step, the set of variables should be able to reduce model error above and beyond game location and opposition quality.

# METHOD

## Dataset

The main database from which study data were extracted was the statistics subsection of nba.com, the official website for the National Basketball Association. This website is free of charge and provides public access to detailed NBA game-by-game records and statistics for the past several decades. Three NBA teams did not have the schedules for prior seasons on their website, so I went to basketball-reference.com to get data for these matchups. This is another website that provides public access to basketball records and statistics. Data from these websites were extracted and manually entered into an SPSS data file; the data could not be downloaded, so they had to be entered manually. All data were taken from the 2016-2017 NBA season.

## Sample Size Calculation

There were 12 predictors in the underlying model for this study: game location, crowd size, opposition quality, unique number of five-man lineups, number of passes, number of uncontested field goals attempted by the focal team, number of shots attempted in the paint by the opposing team, and the number of contested shots taken by the opposing team, number of rebounds, blocks, steals, and turnovers. Refer to Figure 2 to see this conceptual model. The guidelines outlined in Jacob Cohen's (1988) book on statistical power analyses were used to determine a minimum sample size that would provide sufficient power while assuming a small effect size (Cohen's d=.20) for all effects. Based the number of predictors, recommended power level, and estimated effect size, Cohen (1988) recommended a sample size of at least 406 games. Therefore, at least 406 games had to have been selected from the 2016-2017 NBA season. In the NBA, each team plays each other team several times in the same season. When two teams play each other, this is called a matchup. If all games in the season were included in the analysis, this would create statistical dependencies because the same matchup would appear multiple times in the dataset. In order to avoid this dependency, only one matchup between any two teams was included in the analysis.

To select the games, the 30 teams were alphabetized by the first word of the team name. The first team in the sequence was considered as "Team A," the next team was considered "Team B," etc. Data from the first matchup between "Team A" and all other teams in the league were recorded. To find the first matchup between two teams, I went to the focal team's website on nba.com and viewed their 2016-2017 schedule. On this schedule, there is an option to filter which opposing teams are visible; I filtered out all teams except the desired opposing team in the matchup. This showed when the first matchup took place between the two teams. I then went back to the statistics subsection on nba.com and extracted data from this matchup. This process was repeated with all other teams. See Figure 1 for an example of what the data looked like once they were extracted from the database. If either of the teams in their first matchup had played fewer than five games at that point in the season, the next matchup between the two teams was selected instead of the first. This is to ensure that the teams' winning percentage was stable; a winning percentage with few games (e.g. one win and zero losses) does not contain enough variance to be stable. Because there are 30 teams in the NBA, there were 435 ways these teams can be paired together. Five matchups had to be omitted due to missing data. An additional matchup was omitted because nba.com reported that there were no field goal attempts in the paint, which is virtually impossible and was likely an error by the website. The final sample size was 429 games, which still exceeds the minimum sample size suggested by Cohen (1998).

Once all of the matchups were selected and entered into an SPSS file, I chose which of the two teams was considered the focal team. The home team in the first matchup was the focal team, and in the next matchup, the away team was the focal team. This process was continued so that the focal team was the home and away team an equal amount of times.

## Measures

### Game Location

Each focal game was played at one of the two teams' home cities. There is a possibility for the teams to play at a neutral site where the stadium belongs to neither team, but this did not occur in the 2016-2017 NBA season. If the focal team played in its own stadium, then this was considered a home game and was coded as "1." If the focal team played at the opposing team's stadium, then this was considered an away game and was coded as "0."

### Fan Support

Basketball arenas are usually filled with fans from the home city who cheer on the home team. As mentioned previously, research has shown that the effect of home field advantage increases as crowd size increases; fan support is conceptualized as the interaction between crowd size and game location. For home teams, the number of people attending the game was used as a proxy for fan support. For away teams, the value was set to zero because the crowd size only increases the effect of home field advantage for the home team relative to the away team.

### Opposition Quality

I used the opposing team's winning percentage *the day the game was played* as a measure of opposition quality. To get this percentage, I divided the total number of games won by the total number of games played. Higher-quality teams will usually have a better ratio of wins to losses than lower quality teams. At the very beginning of a season, a team's winning percentage does not convey much information about the quality of the team. A team needs to play several games before the winning percentage has enough variance to be meaningful. Because of this, no matchup in which either team had played fewer than five games was analyzed.

**Game Management**

Coaches try to improve their team's chance of winning by strategically managing which players are currently on the court at all times. Prior research, as mentioned previously, does indeed show that coaches strategically manage the game by taking timeouts and by substituting players in and out of the game. Certain player lineups will be more appropriate in certain situations, and coaches must be able to recognize these situations and respond by selecting the optimal player lineup for that situation. A team may be highly skilled, but they will likely not perform well if the coach does not manage the players appropriately. The total number of unique five-man lineups the coach utilizes during a particular game served as a measure of game management.

**Aggregated Role Performance**

As a reminder, role performance was defined by the STE model as how well an individual performs functions attached to his or her role on the team. To calculate role performance, I had to first identify the key game-related statistics that reflect taskwork and were not directly related to scoring. If the statistics were directly related to scoring points (e.g. field-goal percentage or assists), then this would give an artificially high correlation with winning. Using statistics related to scoring to predict winning is essentially using an outcome to predict another outcome. There are several important statistics in basketball, however, that are not inherently tied to scoring. Namely, these are rebounds, blocks, steals, and turnovers. Each of these statistics reflects taskwork behavior rather than teamwork behavior; they do not necessarily require the coordination of two individuals to be executed. All of these behaviors are important to all of the roles in basketball and can therefore be aggregated (i.e. individual-level variables combined into team-level variables) without regard to the actual player or role that performed them. The total number of rebounds, blocks, steals, and turnovers done by the focal team during a game were aggregated, providing four distinct measures of role performance.

This way of measuring aggregated role performance is not ideal because it does not consider the differences across teams or within teams over time. This method of measurement includes the tasks that all of the roles share rather than the totality of tasks that can be encompassed by any given role. An ideal measure of role performance would involve having an expert watch the athletes play and code for how well each role was fulfilled. Additionally, one would have to account for the possibility of players changing roles in the middle of the game, which does occur in basketball. Roles can also change from team to team, which makes it difficult to standardize the way role performance would be measured. The cost and time of measuring role performance in this manner is not feasible for a project of this size. In summary, there were four measures of role performance–aggregated rebounds, aggregated steals, aggregated blocks, and aggregated turnovers.

**Teamwork**

To attempt to most fully capture all aspects of teamwork, offensive and defensive measures must be considered. There were four measures of teamwork used in this study: total number of passes made by the focal team, number of uncontested shots taken by the focal team, number of shots attempted in the paint by the opposing team, and number of contested shots taken by the opposing team. For offense, the number of passes made during a game and number of uncontested field goals attempted by the focal team were used. Teammates must coordinate in time and space when passing the ball around the court, and these passes must be strategically made so that a player can take an open shot. For defense, the number of shots attempted in the paint by the opposing team and the number of contested shots taken by the opposing team were used. A shot inside the paint in basketball can be argued to be a breakdown in the focal team's defensive process. Shots in this area are close to the basket and are much easier to make than shots taken further back, therefore, teams work to prevent the opposing team from entering this area. Team members must also coordinate to defend all members of the opposing team and contest any shot they make.

I conducted an additional analysis that examined how teamwork relates to team effectiveness when aggregated into one variable (i.e. combining two team-level variables into one composite variable). To do this, I first converted all four variables into z-scores. Then, similarly to the role performance aggregation method, I added the z-scores for contested field goals by the opposing team, uncontested field goals by the focal team, and number of passes by the focal team. I then subtracted the z-score for number of shots attempted in the paint by the opposing team because this was expected to be negatively related to winning.

All of the variables for teamwork were taken from the NBA's Player Tracking system, which utilizes software called SportVU to record these data. For each game, six cameras are placed on the catwalks of the stadium, and these cameras capture the movements of each player and the basketball 25 times per second. This allows the NBA to collect data regarding player speed, distance travelled, whether or not a shot was contested or not, where the ball was shot on the court, etc. The NBA does not go into much detail about this software on their website, but one can assume that this software makes it easier to code for these more subjective variables. There is little to no research that assesses the reliability of this software. However, because it is utilized by the NBA, one can assume that it provides the highest-quality data available on these teamwork variables. One can also assume that the NBA is the most reliable source for all data regarding NBA games. Other scholars, such as Kubatko, Oliver, Pelton, and Rosenbaum (2007), have extracted data from nba.com as well.

### Game Outcome

Winning a game by the focal team was coded as a "1" and losing a game was coded as a "0." There were no ties in the 2016-2017 NBA season.

## Procedure

A previous section explained how the games were selected; this section will outline exactly how the data from the games were extracted. First, a team's official website on nba.com was accessed. Next, the team's 2016-2017 schedule was viewed by clicking the "schedule" tab on the team's website and by changing the season to 2016-2017. The opposing team was selected by clicking "filter" and choosing the desired team. This showed all matchups with that team. The date of the first matchup between the teams was noted. The game was checked in order to ensure that both teams had played at least five games before the start of that game. This was checked by going to the home page of nba.com, clicking on "stats," clicking on "scores," and selecting the date on which the game occurred. This page showed the **game outcome** and the opposing team's win-loss record after the game finished. I converted this to **winning percentage** by dividing the number of games won by total games played. If either of the teams had played fewer than five games before the start of the game, then the next matchup between the two teams was selected.

For the rest of the data, I clicked on “box score.” On this page, the **crowd size** was displayed under “attendance.” To get the number of **unique five-man lineups**, I clicked “lineup” under the focal team. This displayed each unique five-man lineup in rows. The number of rows was then counted. To get the **number of passes** made during the game by the focal team, I clicked on the dropdown menu labelled “traditional” and changed it to “player tracking.” There was a column labelled “PASS,” and at the bottom of the focal team’s data was the total number of passes made during the game. To get the number of **contested shots taken by the opposing team**, I looked under the column that says “CFGA,” which stands for contested field goals attempted. The value of interest was under the opposing team’s data rather than the focal team. To get the number of **uncontested shots taken by the focal team**, I looked under the column that says “UFGA,” which stands for uncontested field goals attempted. This was under the focal team’s data. To get the **number of field goals attempted in the paint by the opposing team**, I looked under the column that says “DFGA,” which stands for field goals defended at the rim. This does not include every shot that is taken in the paint, but includes the ones that are attempted close to the basket, which is essentially what this measure is trying to capture. This variable was in the focal team’s section of the data. To get the number of **blocks, steals, rebounds**, and **turnovers** for the team, I clicked the dropdown box that says “player tracking” and change it to “traditional.” This displayed a page that included these statistics. On this page, there were columns labelled “REB,” “TOV,” “STL,” and “BLK.” “REB” refers to rebound, “TOV” stands for turnover, “STL” stands for steal, and “BLK” stands for block. At the bottom of these columns, there was a value for the team total for that game. For all of these statistics except winning percentage, the webpage displayed the value I needed; I did not have to convert or alter the values in any way. An example for how the data looked in SPSS can be seen in Table 3.

# RESULTS

## Analyses

For Hypotheses 1-7, the point-biserial correlation coefficient between the various continuous predictors and dichotomous game outcome was calculated to determine if each focal predictor was significantly correlated with team effectiveness.

For Hypothesis 8, multiple logistic regression was used to see how the model's predictor variables are related to winning. Linear regression is inappropriate to use due to the fact that binary data do not have a normal distribution, which is a condition needed for multiple linear regression. Additionally, because the goal is to calculate the retroactive probability a team would win a game, the predicted outcome must logically fall somewhere between zero and one in order to make sense. Multiple linear regression could produce values outside of this range, which would be conceptually meaningless. The statistic of interest here for all of the STE predictors is their odds ratio (OR), which is a predictor-level statistic that represents the change in likelihood of winning for each one-unit increment of the predictor. For every one unit increase in the predictor value, the odds ratio shows how much the percent chance of winning a game changes while holding all other variables constant.

For Hypothesis 9, hierarchical logistic regression was used to examine the extent to which a specified set of variables decreased model error after controlling for game location and opposition quality. For this hypothesis, game location and opposition quality were entered at step one, and all other variables were entered at step two. The model-level statistic of interest here is the decrease in -2LL, which captures model error. This was expected to significantly decrease between step one and step two of the hierarchical logistic regression. I also assessed the significance of the predictors at step two by examining the p-value associated with their respective odds ratios (OR). The OR represents the likelihood that a certain outcome would occur.

With regard to characterizing the magnitude of observed relationships, according to Cohen (1988), a correlation around $r = .10$ represents a weak correlation while a correlation of around $r = .30$ represents a moderate correlation. Alpha was set at .05. As mentioned previously, the initial sample size was 435 matchups, but five matchups were omitted due to missing data. An additional matchup was deleted due to seemingly incorrect data on nba.com. Therefore, the overall sample size was 429, so this can be assumed for each analysis unless otherwise noted.

**Hypothesis Testing**

Hypothesis 1 predicted that teams playing at home would be more likely to win. As expected, there was a significant and positive correlation between game location and game outcome ($r = .128$, $p < .05$), with 57.2 percent of focal teams playing at home winning the game. Even though game location was significantly correlated with winning, the magnitude of the correlation was rather weak. Nevertheless, Hypothesis 1 was supported.

Hypothesis 2 predicted that there would be a positive relationship between crowd size and winning for focal teams playing at home. As mentioned before, this correlation only included games in which the focal team played at home. There was a non-significant relationship between crowd size and game outcome for teams playing at home ($r = .072$, $n = 215$, $p > .05$). Therefore, Hypothesis 2 was not supported.

Hypothesis 3 predicted that there would be a negative correlation between opposition quality and the focal team winning each game. Opposition quality was indeed significantly and negatively correlated with winning when operationalized as the opposing teams' winning percentage as of the day of the game, ($r = -.228$, $p < .05$). This means that as the quality of the opposing team increases, the focal team won less often. Interestingly, there was also a significant and negative relationship when opposition quality was operationalized as the opposing teams' season winning percentage ($r = -.292$, $p < .05$). Thus, opposition quality, especially when operationalized as season winning percentage, was moderately correlated with the focal team winning the game and its correlation ($r = -.292$) is the strongest correlation of all of the focal predictor variables. Therefore, Hypothesis 3 was supported.

Hypothesis 4 predicted that there would be a positive correlation between number of unique five-man lineups used by the focal team and the focal team winning the game. This relationship was not significant ($r = -.074$, $p > .05$). Interestingly, this correlation, although not significant, trended in the opposite direction as initially expected.

Hypothesis 5 predicted that there would be a positive correlation between a set of statistics capturing aggregated individual role performance behaviors and the focal team winning the game. As expected there was a positive and significant relationship between rebounds and winning ($r = .204$, $p < .05$), steals and winning ($r = .109$, $p < .05$), and blocks and winning ($r = .188$, $p < .05$). In general, this means that teams that obtained more rebounds, steals, and blocks won more often. Therefore, Hypothesis 5 was supported.

Hypothesis 6 predicted that there would be a negative correlation between turnovers and the focal team winning a game, and there was in fact a negative and significant relationship between turnovers and winning ($r = -.159$, $p < .05$). In other words, teams that committed more turnovers won less often, although the correlation was somewhat weak. Nonetheless, Hypothesis 6 was supported.

Hypothesis 7 predicted that there would be a positive relationship between three of the focal teamwork behaviors (number of passes made by the focal team, number of uncontested shots taken by the focal team, and the number of contested shots taken by the opposing team) and the focal team winning the game. Hypothesis 7 also predicted that there would be a negative relationship between the number of shots attempted in the paint by the opposing team and the focal team winning a game. Surprisingly, there was a nonsignificant relationship observed between passing and winning ($r = .008$, $p > .05$), uncontested field goals attempted by the focal team and winning ($r = .045$, $p > .05$), and number of shots attempted in the paint by the opposing team and winning ($r = .091$, $p > .05$), which was in the opposite direction than expected. There was a positive and significant relationship between number of contested field goals by the opposing team and winning ($r = .106$, $p < .05$), although this correlation was rather weak. This reflects that teams that contested more field goals taken by the opposing team won more often. Therefore, Hypothesis 7 was partially supported. A summary of item-by-item correlations, means, and standard deviations can be seen in Table 1. The means and standard deviations for the focal variables separated by winning and losing teams can be seen in Table 2.

Hypothesis 8 predicted that the focal variables would each have a significant relationship with winning while controlling for the other variables in the model. A one-step multivariate logistic regression was used to test this hypothesis. The focal statistics for this hypothesis were the odds ratios of each individual predictor. A significant odds ratio indicates that the odds of winning the game significantly changed when the variable increases by one unit. All of the focal variables were entered at the same step.

As shown in Table 4, game location, opposition quality, rebounds, turnovers, steals, and blocks were significant while controlling for other variables. For each additional rebound the chance of winning the game increased by 8.2 percent (OR=1.082, $p < .001$). Every turnover decreased the focal team's chance of winning the game by 12.5 percent (OR=.875, $p < .001$). Similarly, each additional steal increased the focal team's chance of winning the game by 17.0 percent (OR=1.170, $p < .001$), and for each additional block, the chance of winning the game increased by 10.3 percent (OR=1.103, $p = .047$). When controlling for the other predictors, a team's percent chance of winning a game increased by 59.7 percent when the team played at home rather than away (OR=1.597, $p = .004$). Similarly, as the opposing team's winning ratio changed from 0 to 1.0, then the percent chance the focal team had of winning the game decreased by 94.9 percent (OR=.051, $p < .001$). Of course, no team in the league had all wins or all losses; this result just shows theoretically how the odds ratio would change if this were the case. The odds ratio must be interpreted this way because the data for opposition quality were entered as a proportion rather than a percentage crowd size, lineups, and all teamwork variables were not significant. Therefore, Hypothesis 8 was partially supported.

Hypothesis 9 predicted that the focal STE predictors as a set would result in significant model improvement compared to the two well-established predictors of game location and opposition quality. Hierarchical logistic regression with predictors entered at two steps was used to test this. Game location and opposition quality were entered at step one and all other variables were entered at step two. The focal statistic for these two hypotheses was the significance of the decrease in model error (i.e. -2LL), which would indicate that the model improved significantly. Before any variables were entered into the model, the base rate (i.e. constant) had an overall classification accuracy of 50.8 percent. As expected, the model error significantly decreased when game location and opposition quality were entered at step one [$\chi^2(1, N= 429) = 31.49$, $p < .001$], and the overall classification accuracy for the model improved from 50.8 percent to

61.1 percent at step one. This means that the model correctly retroactively predicted the winner of the game 61.1 percent of the time when the data for game location and opposition quality were available. Additionally, Nagelkerke's pseudo R-squared at step one was .094, indicating that game location and opposition quality explained roughly 9.4 percent of the variance in winning.

When the other STE predictors were entered at step two, the statistical model significantly improved as well, which can be seen in Table 5, [$\chi^2(1, N= 429) = 61.078, p < .001$]. The predictors significantly related to winning at step two were game location (OR=1.597, $p = .032$), opposition quality (OR=.051, $p < .001$), rebounds (OR=1.082, $p < .001$), turnovers (OR=.875, $p < .001$), steals (OR=1.170, $p < .001$), and blocks (OR=1.103, $p < .001$). Consistent with this, the classification accuracy for the model improved from 61.1 percent to 67.4 percent at step two. Additionally, Nagelkerke's pseudo R-squared at step two was .259, meaning that the model explained roughly 25.9 percent of the variance in game outcome. Therefore, Hypothesis 9 was supported.

## Follow-up Analyses

I conducted a total of three follow-up analyses. First, I wanted to explore whether teamwork would significantly reduce model error when entered as two separate offensive and defensive composites as opposed to four separate variables. This was to done to see if aggregating the teamwork variables yielded a different result than entering them separately. Next, I wanted to examine potential curvilinear effects for both passing and number of unique lineups. Each of these analyses was conducted separately. Unlike other behaviors in basketball (e.g. rebounding, blocking, scoring points, etc.), there is arguably a point at which passing the ball or substituting a player has diminishing returns. Passing and substituting are only beneficial up to a certain point after which the team's performance may suffer. A team that does not pass the ball enough may not be able to get enough open shots while a team that passes the ball too frequently may be missing opportunities to score. Similarly, making too few substitutions would prevent the players on the court from resting while substituting players too frequently might disrupt the flow of the game. Thus, the number of passes and lineups a team uses during a game might have a curvilinear relationship with winning.

**Teamwork Composite Analysis**

For the first additional analysis, a hierarchical logistic regression with predictors entered at two steps was conducted to examine the extent to which the two teamwork composites decreased model error beyond other STE predictors already in the statistical model. Two composites for teamwork variables were created via the method mentioned earlier. As a reminder, number of passes made by the focal team and number of uncontested field goals attempted by the focal team were aggregated into a measure of offensive teamwork while number of uncontested shots and shots in the paint taken by the opposing team were aggregated into a measure of defensive teamwork. All STE predictors except teamwork were entered at step one, and the two teamwork composites were entered at step two. The focal statistic was the significance of the decrease in model error at step two. As seen in Table 6, the model unfortunately did not improve significantly between steps one and two. This suggests that regardless of how teamwork is aggregated, it does not reduce model error. This does not necessarily mean that the variable is not important, but perhaps the way it was operationalized did not fully capture the construct. More discussion on this will be offered in a later section.

**Curvilinear Analysis for Passing**

For the second additional analysis, I examined the relationship between passing and winning to see if a curvilinear relationship existed rather than a linear relationship. For both this analysis and the next, I was looking for an inverted-U pattern, which would signify that an increase in the number of passes, for example, is only beneficial up to a certain point. After this point has been passed, then additional passes would be expected to negatively impact team effectiveness. To do this, I entered all zero-order STE predictors except passing at step one, zero-order number of passes at step two, then the nonlinear passing terms at step three. To create the nonlinear passing terms, I squared the number of passes for each matchup. The model did not significantly improve between steps two and three, suggesting that there is no curvilinear relationship between passing and winning ($\chi^2(1, N= 429) = 1.113, p > 05$).

**Curvilinear Analysis for Number of Unique Lineups**

For the third additional analysis, I similarly examined the curvilinear relationship between number of unique lineups and winning. Again, this was done because the benefit of making more substitutions might diminish after some point. To do this, all other STE variables were entered at step one, lineups at step two, then the nonlinear lineups terms at step three. The nonlinear lineups terms were created by squaring the number of lineups made per matchup, similar to how the nonlinear passing terms were made. The model did not significantly improve between steps two and three, suggesting that there is no curvilinear relationship between the number of unique lineups used in a game and winning ($\chi^2(1, N= 429) = .013, p > .05$).

# DISCUSSION

## Summary of the Major Findings

This study makes two main contributions to the literature and establishes the predictive power of game location and opposition quality. First, well-established predictors of winning in sports, namely game location and opposition quality, did indeed predict winning in basketball significantly better than chance alone. Second, some variables from the STE model had significant bivariate relationships with winning, providing preliminary support for the theoretical model. These variables were game location, opposition quality, blocks, steals, rebounds, turnovers, and number of contested shots taken by the opposing team. Significant relationships between STE predictors and winning provide support for at least part of the theoretical model. Third, the STE model variables significantly decreased prediction error above and beyond game location and opposition quality. However, game management and three out of four teamwork variables were not associated with winning and did not significantly improve the model. This is a significant finding because this shows that STE predictors can help explain winning beyond what game location and opposition quality can explain. These two variables were shown to be robust predictors of winning in previous research, so improving upon this provides further support for the STE model.

The next section will further examine these three main contributions, discuss implications of these findings and why some hypotheses were not supported, and discuss if these findings can be generalized to other sports. Following this, I will address some limitations of the study and identify several future research directions based on these limitations, and then briefly suggest some practical applications of these findings. Finally, I will end by providing some conclusions.

## Contribution to the Literature

The first contribution to the literature was confirming the robust predictive power of game location and opposition quality in relation to winning in sports. More specifically, I provided the odds for accurately predicting the winner of the game when considering both game location and opposition quality, which few to no studies have done. Both of these variables had significant relationships with winning. Opposition quality was significantly and negatively related to winning when operationalized as the opposing team's winning percentage the day of the game ($r = -.228$) as well as when it was operationalized as the opposing team's season winning percentage ($r = -.292$). These two correlations did not significantly differ from each other ($z = -1.00$, $p = .316$). These relationships were expected as prior literature repeatedly found these effects.

The robust relationship between winning and both game location and opposition quality makes it possible to successfully retroactively predict the winner of a basketball game with 61.1 percent accuracy. This is statistically significantly better than the null model. Although, the extent to which these findings can generalize to other levels of basketball and other sports is unknown. Game location has been found to be significantly related to winning in other sports and at other levels of basketball because meta-analytic results have found that the phenomenon of home field advantage is relatively stable across situations (Jamieson, 2010). No such meta-analysis exists for opposition quality. However, as previously stated, previous research has found it to be a fairly robust predictor of winning. Overall, this study shows the extent to which the winner of a basketball game can be retroactively predicted using these two variables.

The second major contribution to the sports literature involved testing a theoretical model of sport team effectiveness. This study was the first to empirically test a portion of the STE model, so many of the relationships in the model were estimated for the first time. As mentioned previously, the variables significantly related to winning other than game location and opposition quality were blocks, steals, rebounds, turnovers, and number of contested shots taken by the opposing team. On the other hand, the number of unique lineups, crowd size, number of passes by the focal team, number of shots taken in the paint by the opposing team, and uncontested shots taken by the focal team were unrelated to winning. These nonsignificant relationships were surprising, especially those relating to teamwork. Basketball is a highly interdependent sport, and virtually all people familiar with the sport would likely say that teamwork is important.

One qualification about these nonsignificant relationships is the questionable construct or content validity of certain variables (e.g. teamwork and game management). The way these variables were measured may not fully capture the construct. This study utilized archival data, and perhaps I did not formulate good measures of the focal constructs. If the measures were improved in a future study, then these nonsignificant relationships may indeed be significant.

A third major contribution of this study was examining the extent to which the STE model reduces model error above and beyond game location and opposition quality. When the proximal STE predictors were entered at the second step of a two-step hierarchical logistic regression, model error was indeed significantly reduced compared to just using game location and opposition quality. However, this significant reduction may have been due largely to the fact that every aggregated role performance measure was correlated with winning. Additional analyses showed that other versions of teamwork did not significantly reduce model error either. Again, this finding was not expected. The reduction in model error may have been greater if I had employed better measures of teamwork and game management. The main takeaway is that the STE model did have some support.

Not all of the focal STE variables played a critical role in reducing model error; the main driver in this reduction was role performance, which is only a single variable. In order for me to comfortably conclude that the STE model was useful in predicting winning, more than one of the focal variables within the model would have to have been related to winning. Additionally, only the proximal antecedents of winning were analyzed in this study, so we do not yet know how accurate the STE model as a whole would be. Nevertheless, the model did receive some support, which makes future research in this domain fruitful.

## Theoretical Implications

Overall this study provided some preliminary support for the STE model, although more work needs to be done. We now know that the STE model does help explain winning above and beyond game location and opposition quality, which are two established predictors of winning in sports. Specifically, we found that aggregated role performance was a good predictor of winning. One measure of teamwork, the number of contested shots taken by the opposing team, was also found to be significantly related to winning. Game management and the other measures of teamwork were not related to winning, and I will examine why this may be so in an upcoming section. More research needs to be done in order to fully understand these relationships.

It is also important to note that this study only provided empirical evidence for the utility of the proximal antecedents of winning. We still do not know if the theory and structure of the rest of the model is accurate. Some of the variables included in this study, including game management, teamwork, and role performance, may mediate various relationships with winning as suggested by the STE model. These relationships should be tested to see if they can fully mediate the relationship between previous antecedents and winning. Additionally, we do not know if sport interdependence moderates the relationships between role performance and winning and teamwork and winning as suggested by the model. This could not be tested in this preliminary investigation because only one sport was used. Two sports of differing interdependence must be used in order to test this moderating effect.

There are at least three potential reasons why some STE predictors were not related to winning. These are: (1) the data could have been non-representative such that the sample did not accurately represent the population of all NBA games, (2) the STE model could have been mis-specified, or (3) the measures could have lacked content or construct validity. First, poor data for this study could have resulted in inaccurate findings. If the data were skewed or not representative of game data from the NBA, then this would lead to results that were also not representative of the whole population. However, a whole season's worth of data was examined in this study, so the chance of all of these data being unrepresentative seems low. This possibility would be more plausible if the sample size was smaller, as smaller sample sizes tend to increase the chance of not accurately representing the population.

Second, the non-significant relationships in this study could have resulted from the STE model being incorrectly specified. If the theory behind a study does not accurately represent reality, then naturally the results would usually not be significant. I have already suggested that the data for this study are probably a good representation of reality, but if these data are paired with poor theory, then the results will likely not be significant. However, the STE model was based on a systematic review of the sports literature. In order for the STE model to be faulty, then a large amount of prior literature would have to be wrong. Alternatively, perhaps game management and teamwork are not directly related to winning; they may instead be related to some other variable in the STE model. However, this is likely not the case because we did not find any literature to suggest this, which only leaves one plausible explanation for why teamwork and game management were not good predictors of winning.

The third reason why teamwork and game management might not have been good predictors is that the measures could have lacked construct or content validity. Researchers try to choose measures that fully represent the construct of interest. However, if the measures that were used poorly represent the underlying constructs, then this could obscure the findings and result in a non-significant relationship when, in reality, better measures of the constructs are indeed related. I attempted to fully capture the construct of teamwork by including both offensive and defensive measures. However, game management was represented by one measure, which was probably not sufficient to fully capture the entire construct. Data regarding game management in professional basketball are scarce, which is the reason only one measure was used. Thus, the reason that these two variables were not related to winning might have been because the underlying constructs were not accurately represented by the measures.

When creating the STE model, we intended it to apply to all team sports with more than two members on the team. The findings of this study may apply to sports other than basketball as well as multiple levels of basketball (e.g. youth, high-school, collegiate, etc.). The rules of basketball, regardless of the level at which it is played, remain relatively constant. Most basketball teams have similar roles, plays, and goals, so the game does not drastically change from level to level. Thus, the variables that impact winning should be similar to those at the professional level, suggesting that these results can be generalized to other levels of basketball. Further, there is reason to believe that many of the relationships would hold in other professional sports. Professional team sports have several similarities. They often draw in large crowds and often earn millions of dollars in revenue each year. Furthermore, the athletes on professional teams are usually at the top of their sport. The variables in the STE model are not unique to basketball; they are expected to be relevant in all team sports. Therefore, I would expect many if not most of the relationships between the STE variables and winning to remain consistent across professional sports. Testing the STE model with other sports and other levels of basketball could lead to interesting research in the realm of team sports, which I will discuss next.

## Limitations and Future Research

There are seven notable limitations in this study that could have impacted the results and should be improved upon in future research. First, only one sport, basketball, was analyzed in this study, which makes it difficult to determine if the results would generalize to other sports. The difficulty in analyzing other sports is finding data that represent the underlying constructs. Many other sports were considered for this study, but it was difficult in finding archival data for all of the focal constructs. Other methods for collecting data, such as behavioral observation, were not feasible due to time constraints. Future researchers should consider other methods of data collection, such as self-report or behavioral coding. For example, when examining teamwork, a researcher could watch a video of a game and code for certain teamwork behaviors rather than relying solely on archival data. This could provide a more accurate measure of teamwork because it would allow the researcher to code for any in-game behavior rather than relying on archival databases, which likely do not include data for all possible teamwork behaviors.

Second, I only included one measure for game management, which could have had limited construct validity. The number of unique lineups may indeed be an important measure of game management, but this measure by itself probably did not capture enough of the construct in order to be statistically significantly related to winning. Furthermore, this measure could have been contaminated because not all lineups used by the coaching staff are based on strategy; coaches may substitute players for non-strategical reasons such as when a player is injured or is in foul trouble. Few data are available to the public that capture how well a coaching staff manages a game. Future researchers should find or create other ways to measure game management. This might be done by analyzing how coaches of high school teams manage their teams during games. Coaches at this level rather than at the professional level might be more willing to allow researchers to observe them and answer their questions. When analyzing basketball, researchers could count the number of substitutions made during a game rather than the number of unique lineups. This would increase variability and may be a better measure of game management. A coach may make many substitutions during a game but use few unique lineups; the way I measured game management could not account for the number of times a specific lineup appeared during the game. Future research needs to be done in order to determine if the number of substitutions is a better measure of game management. I could not use the number of substitutions for this for this study because counting the number of substitutions per game for a sample size this large would be much too time-consuming and burdensome.

Future research on this should also consider other ways to measure game management. Researchers could examine the effects of timeouts and how coaches strategize with their team during these timeouts. This could be done by coding for certain behaviors displayed by the coach or by interviewing the players and coaching staff about how the team strategizes. Finally, researchers could observe how the coaching staff communicates with the team during a game. Players might respond differently depending on the coach’s tone of voice or demeanor. These are just a few possibilities that could be considered for future research.

Third, the way aggregated individual role performance was measured was not ideal, although it was the best that I could do within the constraints of this project. Identifying all of the roles for every team and behaviorally coding for how well players fulfilled these roles would have been ideal. This was beyond the scope of this project. Therefore, I had to make an assumption that there were certain behaviors for which all roles on a basketball team are equally responsible. I did not consider the extent to which each individual role may be more or less responsible for these behaviors. Also, roles differ from team to team and even within the same team over time. For example, the roles associated with the position of point guard on one team are usually synonymous with the roles associated with the point guards for another team. However, there may be differences in how the coaches expect these roles to be fulfilled. A better way of measuring role performance would be to identify all roles within a certain team and find a way of measuring how well that role is fulfilled. This is a very difficult task because the researcher must be very familiar with the roles on a specific team before he or she can begin coding for behaviors that fill those roles. In order to accomplish this, researchers could essentially conduct a job analysis by interviewing both the coaches and players. During these interviews, the researcher could identify roles and what tasks are required within these roles.

Fourth, there could be additional variables that impact winning that were not measured in this study. Future researchers should test more relationships in the STE model in order to ensure that the sequence of the mediating pathways is correct. I only tested the direct antecedents of winning in the STE model, but I did not test mediation. The mediating and moderating links within the STE model need to be tested in order to provide further empirical support for the model. Also, there may be other important antecedents to winning that the STE model does not address. If other important variables exist, then this will help researchers revise the STE model.

Fifth, the only outcome variable in this study was whether the focal team won the game or not. Future studies could to consider other outcome variables such as margin of victory, which refers to the difference in points between the two teams at the end of a game. A dichotomous win/loss variable does not convey any information regarding the difference in points. Beating a team by a large number of points is more impressive than beating the same team by a few. Having a continuous outcome variable could provide a researcher more insight as to how the STE variables are impacting team performance.

Sixth, the way fan support was operationalized could be reconsidered. In this study, I had to make an assumption that the majority of the crowd at any given game would be in support of the home team. However, the number of fans supporting the away team likely differs across situations. Perhaps the number of fans supporting the away team is higher when the two competing teams are geographically close to one another or when the two teams are rivals. Additionally, crowd density rather than crowd size could be considered. Venues differ in their occupant capacity, so a certain number of fans may entirely fill one venue while filling a much smaller portion of another. Players may perceive that the full venue has more fans, which could impact the degree to which fan support influences winning.

Finally, there are a few variables that had limited variability or a low rate of occurrence, which could have impacted their correlations with winning. The average number of lineups used in a game was 15.05 with a standard deviation of 3.63. Other measures could be used (e.g. number of substations) that have a higher base rate of occurrence in basketball, which could increase variability. Next, the average number of steals and blocks was 7.63 (SD=2.89) and 4.95 (SD=2.47) respectively. These are relatively rare in basketball when compared to other player statistics, so when they do occur, they have a chance of having a large impact on the game.

## Practical Implications

The STE model was created to provide a theoretical framework for future research, but it was also intended to help coaches and other sports personnel make more effective decisions in order to improve team effectiveness. Based on the findings of this study, a coach might be able to draw some conclusions that could help improve winning within his or her basketball team. According to the results of this project, aggregated individual role performance was related to winning in basketball. During practices, coaches should focus on drills that develop skills associated with basic roles that everyone on the team shares, although this is likely already being done. The data from this study suggest that this is indeed one of the most beneficial ways a coach can improve the team. Working on behaviors that all roles share (e.g. securing steals, rebounds, blocks, and limiting the number of turnovers) may be more beneficial to the team than working on teamwork skills, such as passing. Data from this study showed that performing well as an aggregate was more strongly related to winning than playing well as a team. If all of the players on the team can effectively perform these shared role behaviors, then this will set up the team to win.

Second, several teamwork related behaviors, including number of passes, uncontested field goals attempted by the focal team, and number of shots attempted in the paint by the opposing team, were found to be unrelated to winning. Coaches might want to reconsider utilizing drills during practice that focus on improving these behaviors. For example, a coach may ask the players to try to pass the ball a certain amount of times before attempting to score; the results from this study suggest that this may not be as beneficial as some may think. Continuously passing the ball and trying to set up the perfect shot may waste too much time and may not be beneficial in the long run. This idea can be applied to other teamwork behaviors as well. Some behaviors, such as passing, may only be beneficial in certain situations. Over the entire game, passing may not be related to winning, but it could be related to scoring during specific plays. I would not suggest abandoning teamwork altogether; I am simply suggesting that more emphasis should be paced on improving aggregated role performance rather than teamwork. One teamwork behavior on which I would recommend focusing would be contesting shots taken by the opposing team. This is the only teamwork variable that was significantly related to winning. Contesting more shots the opposing team takes was associated with winning more, so it would be beneficial for the players to be able to get into a position in which they can contest shots. Again, I would not go so far as to suggest that game management and teamwork are not important, but there do seem to be other constructs, like aggregated role performance, that are more impactful.

In regard to team sports other than basketball, I would suggest that the coaching staff identify behaviors on their team that are important for every athlete to perform well. Improving performance of these shared behaviors may be more beneficial than conducting teamwork drills. This may be more difficult to do in some sports, such as football, in which very few tasks from the many different positions overlap. For example, a wide receiver may not be expected to exhibit behaviors that an offensive lineman would. However, all of the members on the offensive line may be expected to perform similar tasks regardless of their position. The offensive line acts as a subunit that exhibits very distinct behaviors compared to the other positions in football. Therefore, the coaching staff might want to identify these subunits first and then identify the key tasks within these subunits. The results of this study suggest that this may be beneficial. Of course there are many types of sports, so it is up to the experts within those sports to analyze their team in order to identify shared tasks.

Finally, coaches of all team sports should be wary of the compound effects of game location and opposition quality. The results from this study and many prior studies suggest that it becomes harder to win when playing better teams, especially away from home. This may seem obvious, but some athletes may not be conscious of the increased pressure of playing in these tougher games. A particularly tough schedule may lead to more losses, which could negatively impact the players' efficacy. Coaches should spend some time mentally preparing their team so that they can handle the increased pressure of being an underdog in a match. Coaches themselves may want to prepare more for difficult games than easier games by refining his or her game strategy. Future research on this model will help in making more specific practical suggestions.

# CONCLUSION

This study showed that game location, opposition quality, aggregated measures of role performance, and number of contested shots taken by the opposing team were significantly related to winning in professional basketball. However, three out of the four teamwork measures as well as game management were not significantly related. This study also provided some empirical support for the STE model. The STE model was able to significantly decrease model error compared to just game location and opposition quality alone. As the first empirical examination of the STE model, this study provided evidence for the utility of the model in predicting team effectiveness. While some relationships were not significant, several others were, which is encouraging for a preliminary investigation. Overall, the STE model provides an exciting opportunity for researchers to empirically examine winning in sports. This paper ideally will serve as the beginning for a new line of research in the realm of psychology and sports.

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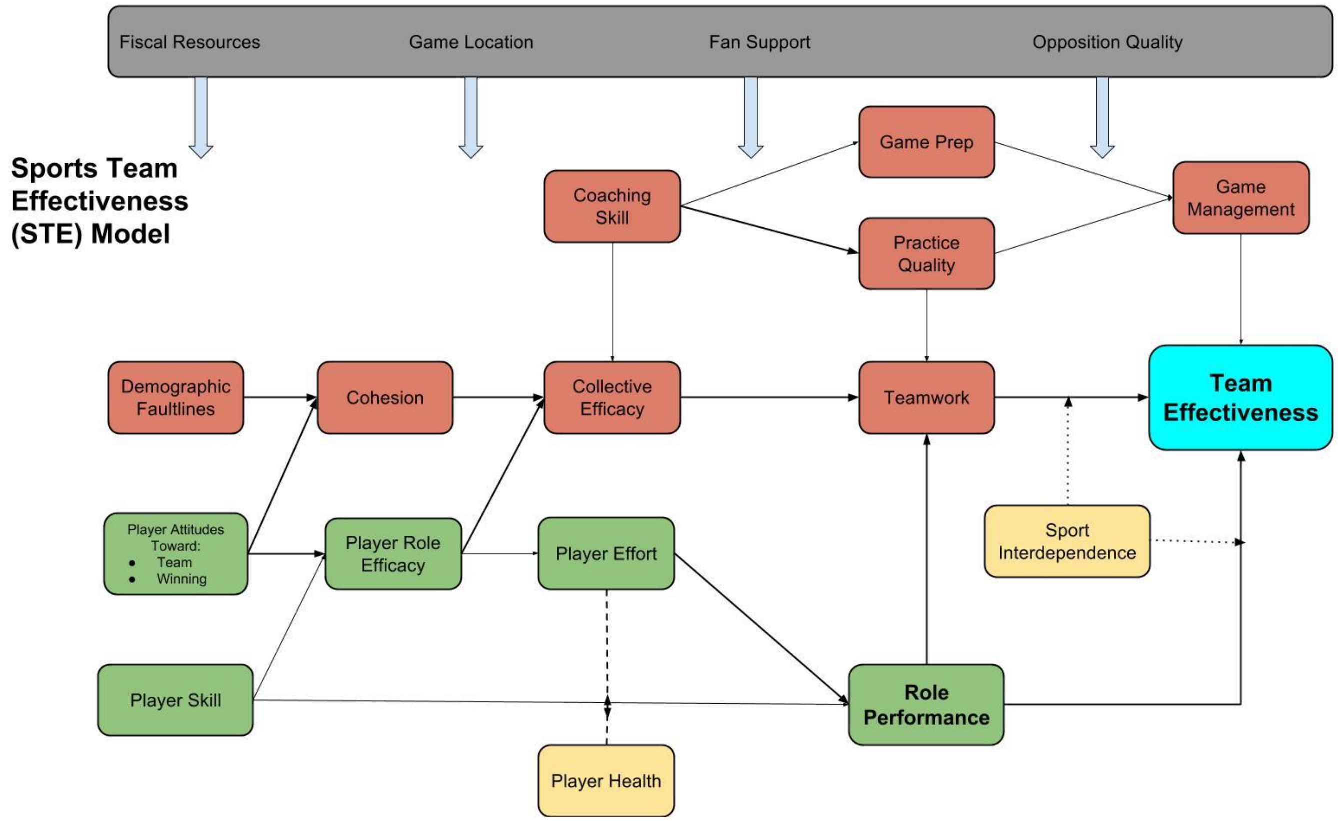
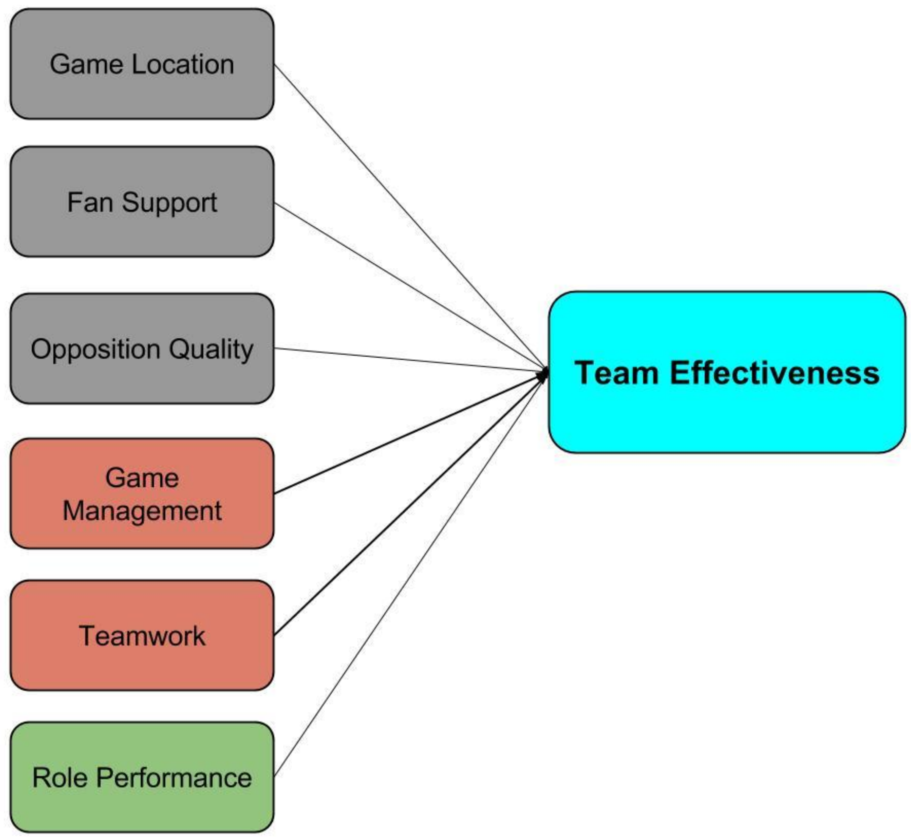
# FIGURES

Figure 1. Model of Sports Team Effectiveness




*Note*: The red variables indicate team-level variables, the green variables indicate individual-level variables, the yellow variables are moderator variables, and the grey variables indicate contextual-level variables.

Figure 2. Thesis Conceptual Model



# TABLES

Table 1. Means, Standard Deviations, and Intercorrelations

| | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Outcome | 0.51 | .50 | | | | | | | | | | | | | |
| 2. Game Location | 0.50 | .50 | .128 | | | | | | | | | | | | |
| 3. Crowd Size | 17616.86 | 2440.90 | -.056 | .019 | | | | | | | | | | | |
| 4. Opp. Quality | .49 | .18 | -.228 | .041 | .202 | | | | | | | | | | |
| 5. Lineups | 15.05 | 3.63 | -.074 | -.042 | .023 | -.032 | | | | | | | | | |
| 6. Rebounds | 43.80 | 6.44 | .204 | .093 | .080 | -.073 | .053 | | | | | | | | |
| 7. Turnovers | 13.38 | 4.14 | -.159 | -.053 | -.086 | -.085 | .212 | .135 | | | | | | | |
| 8. Steals | 7.63 | 2.89 | .109 | .006 | -.29 | .069 | .021 | -.099 | .096 | | | | | | |
| 9. Blocks | 4.95 | 2.47 | .188 | .081 | .025 | -.11 | .121 | .184 | .025 | .012 | | | | | |
| 10. Passes | 301.51 | 35.21 | .008 | -.012 | -.061 | .041 | .240 | .041 | .063 | .047 | .035 | | | | |
| 11. UFGA | 39.82 | 6.25 | .045 | -.035 | -.054 | .134 | -.064 | .087 | -.184 | .139 | .008 | .179 | | | |
| 12. DFGA | 28.87 | 8.36 | .091 | -.009 | .006 | -.038 | .038 | .030 | .026 | -.002 | .344 | -.151 | .003 | | |
| 13. CFGA | 45.45 | 7.50 | .106 | -.018 | .027 | -.074 | .047 | .120 | .036 | -.177 | .287 | -.080 | .017 | .600 | |

*Note*: Correlations stronger than .096 are significant at $p < .05$. Correlations stronger than .109 are significant at $p < .01$.

Table 2. Means and Standard Deviations for Winning and Losing Teams

| | Winning Teams (N=218) | | Losing Teams (N=211) | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| Game Location | .56[a] | .497 | .44[b] | .497 |
| Crowd Size | 17483.29 | 2429.094 | 17754.87 | 2451.14 |
| Opp. Quality | .453 | .168 | .535 | .184 |
| Lineups | 14.78 | 3.632 | 15.32 | 3.611 |
| Rebounds | 45.09 | 6.441 | 42.46 | 6.179 |
| Turnovers | 12.73 | 3.847 | 14.04 | 4.345 |
| Steals | 7.94 | 2.979 | 7.31 | 2.771 |
| Blocks | 5.40 | 2.414 | 4.48 | 2.436 |
| Passes | 301.80 | 38.257 | 301.21 | 31.851 |
| UFGA | 40.09 | 5.850 | 39.54 | 6.639 |
| DFGA | 29.62 | 8.890 | 28.10 | 7.730 |
| CFGA | 46.23 | 7.547 | 44.64 | 7.380 |

*Note*: [a]For winning teams, 95 games were away and 123 were at home. [b]For losing teams, 119 games were away and 92 were at home. UFGA = uncontested field goals attempted by the focal team. DFGA = number of field goals attempted in the paint by the opposing team. CFGA = contested field goals attempted by the opposing team.

Table 3. Example of how the data were entered into SPSS

| | Game outcome | Crowd size | Opposing team winning percentage | Number of unique five-man lineups |
|---|---|---|---|---|
| Team A vs. Team B | 1 | 16704 | 54.17 | 13 |
| Team A vs. Team C | 0 | 16559 | 46.67 | 10 |
| Team A vs. Team D | 1 | 18717 | 60.87 | 11 |

Table 4. Multiple Logistic Regression

| | Variables | β | Wald Test | Odds Ratio | p-value |
|---|---|---|---|---|---|
| Step 1 | Game Location* | .468 | 4.611 | 1.597 | .032 |
| | Crowd Size | .000 | 1.250 | 1.000 | .263 |
| | Opp. Quality* | -2.980 | 21.120 | .051 | <.001 |
| | Lineups | -.049 | 2.369 | .952 | .124 |
| | Rebounds* | .079 | 17.732 | 1.082 | <.001 |
| | Turnovers* | -.133 | 19.471 | .875 | <.001 |
| | Steals* | .157 | 14.262 | 1.170 | <.001 |
| | Blocks* | .098 | 3.936 | 1.103 | .047 |
| | Passes | .003 | .815 | 1.003 | .367 |
| | UFGA Focal | -.008 | .195 | .992 | .659 |
| | DFGA Focal | .003 | .036 | 1.003 | .851 |
| | CFGA Opposition | .026 | 1.881 | 1.026 | .170 |

*Note:* Game location was a dichotomous variable; when the focal team was playing away from home, this was coded as a "0," and home games were coded as a "1." * significant at $p < .05$.

Table 5. Hierarchical Logistic Regression with Two Steps

| | Variables | β | Wald Test | Odds Ratio | p-value | Overall Classification Accuracy | Chi-square (for step) | Nagelkerke's Psuedo R-Squared |
|---|---|---|---|---|---|---|---|---|
| Step 0 | Constant | | | | | 50.8% | | |
| Step 1 | | | | | | 61.1% | 31.49 | .094 |
| | Game Location* | .588 | 8.509 | 1.800 | .004 | | | |
| | Opp. Quality* | -2.776 | 22.613 | .062 | <.001 | | | |
| Step 2 | | | | | | 67.4% | 61.078 | .259 |
| | Game Location* | .468 | 4.611 | 1.597 | .032 | | | |
| | Opp. Quality* | -2.980 | 21.120 | .051 | <.001 | | | |
| | Crowd Size | .000 | 1.250 | 1.000 | .263 | | | |
| | Lineups | -.049 | 2.369 | .952 | .124 | | | |
| | Rebounds* | .079 | 17.732 | 1.082 | <.001 | | | |
| | Turnovers* | -.133 | 19.471 | .875 | <.001 | | | |
| | Steals* | .157 | 14.262 | 1.170 | <.001 | | | |
| | Blocks* | .098 | 3.936 | 1.103 | .047 | | | |
| | Passes | .003 | .815 | 1.003 | .367 | | | |
| | UFGA Focal | -.008 | .195 | .992 | .659 | | | |
| | DFGA Focal | .003 | .036 | 1.003 | .851 | | | |
| | CFGA Opposition | .026 | 1.881 | 1.026 | .170 | | | |

*Note:* * significant at p < .05

Table 6. Hierarchical Logistic Regression with Two Steps with Teamwork Combined into Two Composites

| | Variables | β | Wald Test | Odds Ratio | p-value | Overall Classification Accuracy | Chi-square (for step) | Nagelkerke's Psuedo R-Squared |
|---|---|---|---|---|---|---|---|---|
| Step 0 | Constant | | | | | 50.8% | | |
| Step 1 | | | | | | 61.1% | 31.49 | .094 |
| | Game Location* | .458 | 4.491 | 1.581 | .034 | | | |
| | Opp. Quality* | -3.015 | 22.231 | .049 | <.001 | | | |
| | Lineups | -.042 | 1.819 | .959 | .177 | | | |
| | Rebounds* | .078 | 18.351 | 1.081 | <.001 | | | |
| | Turnovers* | -.126 | 19.068 | .881 | <.001 | | | |
| | Steals* | .142 | 12.862 | 1.153 | <.001 | | | |
| | Blocks* | .126 | 7.428 | 1.135 | .006 | | | |
| | Crowd Size | .000 | .956 | 1.000 | .328 | | | |
| Step 2 | | | | | | 68.3% | 59.587 | .255 |
| | Game Location* | .469 | 4.669 | 1.598 | .031 | | | |
| | Opp. Quality* | -3.013 | 21.649 | .049 | <.001 | | | |
| | Lineups | -.045 | 2.026 | .956 | .155 | | | |
| | Rebounds* | .076 | 17.016 | 1.079 | <.001 | | | |
| | Turnovers* | -.127 | 19.095 | .880 | <.001 | | | |
| | Steals* | .153 | 13.906 | 1.165 | <.001 | | | |
| | Blocks* | .116 | 6.140 | 1.123 | .013 | | | |
| | Crowd Size | .000 | 1.195 | 1.000 | .274 | | | |
| | Off. Teamwork | .043 | .215 | 1.044 | .643 | | | |
| | Def. Teamwork | .199 | 2.006 | 1.221 | .157 | | | |

*Note:* * significant at $p < .05$