THE EFFECTIVENESS OF SERVE LOCATION IN DIVISION 1 WOMENS VOLLEYBALL

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by

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Department of Kinesiology

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Abstract

of

THE EFFECTIVENESS OF SERVE LOCATION IN DIVISION 1 WOMENS VOLLEYBALL

by

Joseph M. Elftmann

Volleyball coaches and players go at great lengths to find competitive advantages against opponents. Many hours are spent practicing, studying game films, and strategizing in the hopes of finding valuable predictors of success.

It is widely accepted that the primary predictor of team success lies in players' ability to both serve effectively and receive serve effectively (McGown, Fronske, & Moser 2001; Papageorgiou & Spitzley 2003). Thus, it is imperative that players and coaches are aware of the best serving strategies to utilize during the course of a match.

Though many studies have attempted to investigate serve success predictors such as mode of serves, force of serves, and rotational velocity of serves, there is a lack of research that identifies the success rates of serves to various locations on the court.

This study investigated the success levels of serves to zones 1, 5, and 6. A total of 120 serves to each zone (total n=360) were quality analyzed using a 0-3 scale (USA Volleyball, 2009). The results were then compared using an analysis of variance (p=0.05) to determine if there were significant differences among the means. It was found
that serves to zone 6 (m= 2.34) were received significantly easier than serves to zone 1 (m= 2.11). Additionally, it was found that serves to zone 1 were received at a significantly lower percentage than serves to zones 5 and 6.

_______________________, Committee Chair
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_______________________
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Chapter 1

INTRODUCTION

Many sport enthusiasts consider volleyball to be the ultimate team sport, where each touch of the ball is directly influenced by the previous touch of a teammate or opponent. In this sense, each impending contact is dependent on the previous, and will then have an affect on subsequent contacts. However, as Karch Kilary (arguably the greatest volleyball player of all time) puts it, “No volleyball play can begin without a serve, and the serve is the only technique that is totally under your control.” Thus, serving is the only play made in which no prior contact directly affects the outcome of subsequent touches.

Other volleyball skills such as blocking, passing, setting, and attacking separate the good teams from the bad, but serving remains the only skill in which a player is in direct control. At the highest levels of volleyball, the most crucial aspect of the game lies in a team’s ability to serve effectively and receive the opposing team’s serve successfully (McGown, Fronske, & Moser, 2001; Papageorgiou & Spitzley, 2003).

The effectiveness of a serve can be quantifiably measured based on the receiving team’s ability to receive their opponent’s serve. This reception is quality analyzed based on the number of attacking options the receiving team’s setter will have in his/her offense. Therefore, the quality of a receiving team’s pass will directly influence the team’s ability to sideout; the more attacking options that a setter has available, the more likely the receiving team is to earn a point (USA Volleyball, 2009).
At the collegiate level, men’s and women’s teams primarily utilize float and spin serves; however, women’s teams rely less on power and force and are typically more concerned with the accuracy and precision of serving location. In an attempt to best control the first touch of a serve, receiving teams utilize various serve-receive formations. Though these formations are intended to best control a serve, they often leave vulnerable areas on the court which a server can exploit. Serving areas, or zones, become exploitable based on spacing constraints, player weaknesses, distance demands, and many other variables.

Regardless of a team’s serve-receive strategies, the court can be divided into six serving zones. The zones are labeled based on the rotation-based rules of volleyball. The zones are determined based on the location on the court and are fixed; zones are not determined by receiving team’s formation and do not change over the course of a match (see Appendix A). Though studies have been conducted in an attempt to quantify the effectiveness of serves based on speed, rotational and angular velocity, and mode of serve; the effectiveness of serving location strategies remains unknown (Moras et. al, 2008; Huang & Hu, 2007; Lithio & Webb, 2006).

Statement of Purpose

The purpose of this study is to examine the effectiveness of serves to various zones on the court. Though a multitude of serves will be analyzed, serving location will be the only variable considered in this study. It is important to note that many variables influence the result of the serve. Match importance, pressure levels, player skill levels, and serve speed are just a few of the other important variables that affect serve success.
Many of these aspects are difficult to quantify; thus, for the purposes of this study, only
the success results of service zones will be taken into consideration.

Significance of Research

Though many coaches and players have personal theories as to which serves are
most successful, there exists minimal research on the measurable success of service
strategies based on zones. This study will allow coaches and players to gain a deeper
understanding of which service zones will best predict successful serving. While so
many variables contribute to serve success, this research will help compile future
research on serving strategies and also offer coaches and players useful information in
regards to service zone strategies.

Definition of terms

1. Serve-receive- the action of one team receiving the opposing team’s serve.
   Usually, serve-receive techniques are dynamic in that they change according to
   the type of serve being employed by the opposing team and are typically set up to
   help the receiving team earn a point.

2. Float serve- similar to a knuckle ball in baseball, a type of serve that follows an
   unpredictable flight path and shifts in the air with little to no spin as it progresses
   over the net to the receiving team.

3. Spin serve- any serve that utilizes spin to create an arcing pattern and follows a
   predictable pattern of flight as it progresses across the net.

4. Attack – also has other names such as spike or hit; the act of imposing force on a
   ball to increase the velocity and angle that the ball travels over the net thereby
increasing the difficulty of receiving such a play.

5. Toss- the action of throwing the ball into the air directly before contacting the ball during a serve.

Limitations

The study will be limited to the matches and serves observed. Servers will not be pre-selected and long-term results of individual players’ serves be will not be taken into consideration. Each serve will be analyzed independently. All serves will have been previously analyzed and quantified and will be reassessed for the purposes of this study’s validity. Other confounding variables such as serving location (in relation to the service line), match score, importance or timing of match, reception strategies, player skill or previous success, etc. will not be taken into consideration for this study.

Delimitations

This study will be limited to serves observed during the 2010-2012 seasons. All data will obtained from California State University, Sacramento. Therefore, the analyzed data will only reflect the behaviors of participating teams and players from the Big Sky conference during the 2010-2012 seasons. For the purpose of this study, only float serves will be analyzed.

Assumptions

This study will assume several things. First, this study will assume that each serve observed was performed with the intention of producing successful outcomes. That is, each serve will be executed with the intention of making the reception of serve as difficult as possible. Another assumption will be that all Division 1 players performing
these serves are considered elite-level volleyball players, regardless of their actual skill level, experience, or previous success.

Hypotheses

It is predicted that there will be a significant difference in the serve reception averages to zones 1, 5, and 6. Hypothesis number 1 predicts that serves to zone 1 will be the most difficult to receive. In order to accept the null for hypothesis number 1, there must exist a statistically significant difference in the reception averages of the three zones. More specifically, the reception average to zone 1 must be significantly more than the serve reception averages to zone 5 and zone 6.

Hypothesis number 2 predicts that serves to zone 6 will be the easiest to control for the receiving team. In order to accept the null for hypothesis number 2, there must exist a statistically significant difference in the reception averages of the three zones.

To test these hypotheses, an analysis of variance (ANOVA) will be used to determine whether or not a significant difference exists among the reception averages. The results of the ANOVA will allow the researcher to accept or reject the null hypotheses.
Chapter 2

REVIEW OF LITERATURE

Across all levels of volleyball, the key to success lies in a team’s ability to serve and serve-receive with higher accuracy than their opponents. While various other components also contribute to team success, these two primary skill sets often dictate the outcomes of matches. Because of this, players and coaches go at great length to understand and practice the types of serves that can be effectively employed during the course of a match (USA Volleyball, 2012).

Purpose of Serve

While the primary purpose of the serve is to initiate the play or rally, an aggressive player or team will properly attempt to make a serve a means of attack against the other team (Gozansky, 1983). Regardless of which type of serve is employed by the serving player, many factors of the receiving team account for the success rate of each individual serve. Situational factors and personnel factors also contribute to serving success. Ultimately, the execution of the proper serve can help a serving team to earn points throughout the course of the match.

According to McGown, Fronske, and Moser (2001), the keys to success in volleyball are the serve and serve reception. Thus, serving aces or missing serves are the fastest and easiest way to earn points in volleyball. Recent rule modifications state that a point will be earned by either team on each serve regardless of which team serves. Thus, a tough serve can make it difficult for the opposing team to run their offense which will increase the likelihood of earning a point on serve (McGown et al., 2001). With this in
mind, there are four characteristics of a serve that make it difficult to control. First, increased velocity will decrease the time your opponents have to decide who will receive that ball and how to best intercept it. Second, position and location of the serve will create opportunities for indecisiveness and errors in communication between players. Third, the type of serve utilized will influence the flight of the ball which will either make the serve easier or harder to interpret from the opposing team. Finally, the choice of serve used will affect their opponent’s ability to properly anticipate the action required to successfully receive the serve (McGown et al., 2001).

As discussed in chapter two of Strategies for Competitive Volleyball, there are many strategies to consider using during the course of a match that can effectively counterbalance the opposing team’s strengths while serving in a volleyball match (Fraser, 1988). Both serving to a specific area on the court and adjusting your own team’s alignment can inhibit the other team’s serve-receive percentage, thus increasing the likelihood of earning points. Serving to a specific player, such as a poor passer or substitute player, can increase the odds of the serving team winning a point. If a weak player cannot be exploited, it is also possible to serve specific areas on the court such as the deep corner or short middle in an attempt to interrupt the receiving team’s plan of attack. As noted early in the chapter, although the term serve technically refers to an offensive action, it is the initiating moment of the rally that gives possession of the ball to the opposing team thereby placing your own team on defense (Fraser, 1988). Therefore, by using the strategies discussed above, it is possible to increase the likelihood of placing your defensive team in a more winnable situation.
Types of Serve

Players, with the assistance of coaches, are constantly thinking of which types of serves to employ in order to increase their chances of winning each rally. Just as each player’s coordination, skill, and talent are unique, so is each individual serve. The way the ball is contacted, the amount of force used, and the type of spin placed on the ball are just a few of the many factors that affect how each ball is served.

As a player begins to develop some of the basic skill sets of volleyball, it is important that he/she can effectively utilize various forms of serves to execute in a match. Two of the simplest techniques are the standing underhand serve and the standing float serve. Though both of these serves are considered two of the easiest skills to learn, mastering the control and speed of these serves may be helpful in achieving success on the court (Viera & Ferguson, 1989). The standing underhand serve may be the simplest to learn and execute, but is often necessary to master before taking on a more complex task such as the overhand float serve. Even at the highest level, a difficult float serve can prove to be one of the most effective serving options as it is both unpredictable to track and also difficult to pass (Viera & Ferguson, 1989). As with all serving strategies, the key to mastering an effective serve begins with the execution of a consistent toss. As mentioned before, the serve is the only skill in volleyball that a player is in complete control over as it is the only action in which a player initiates her own toss. All other skills in volleyball are dependent on the contact of a previous player. Therefore, it is vital that a player is in complete control of his or
her own toss which will lead to a more consistent and effective serve (Viera & Ferguson, 1989).

**Float Serve**

Similar to a knuckle ball in baseball, the floater, or float serve is the most common type of serve employed by elite volleyball players as it can be the most difficult to track and intercept. While all levels of players can utilize the float serve, only the execution of that specific serve will determine the level of success. The speed, contact point, and consistency of the serve will all factor in to the level of success of a float serve (Gozansky, 1983).

All of these forces influence the flight path of a ball, which will ultimately determine the level of success of a serve. The primary intent of a float serve, then, is to exert a specific force upon a ball, which increases the velocity of the ball, while neutralizing its rotational velocity. If this action is successful, the resulting ball carries no spin, and is therefore subject to unpredictable patterns of movements through the air. These flight movements are nearly impossible to interpret from the perspective of serve-receivers. Newton’s first law asserts that there is no object in the universe whose velocity is or can be changed by anything other than the forces acting upon it (Cairns, 2011). In this case, the air pressure, air drag, air temperature, and wind (or the lack thereof), are all factors that influence the flight of a ball which carries zero rotational velocity. To put it simply, a ball that is struck with a large amount of force and zero rotational velocity is near impossible to receive.
Another important factor that influences the floating action of a serve that is often overlooked is the shape and design of the ball itself. Volleyballs are not perfectly round; rather, the balls have seems, indentations, and rough surfaces (at the microscopic level). As a ball travels at various speeds through the air, certain aspects of the ball may be experiencing different levels of drag as the irregularities experience turbulence (Cairns, 2011). Considering the uncontrollable factors mentioned above (air pressure, air drag, air temperature, and wind), one can see why the float serve is scientifically proven to be unpredictable.

The conditions above illustrate the result of a serve with high levels of applied force with zero rotational velocity (spin). Applying such a force without producing any rotational velocity is no easy task. If a player applies force to the ball above it’s center, the ball will carry topspin. If a player applies force to the ball under it’s center, the ball will carry backspin. In order to apply force through a ball which results in zero spin, players can utilize several strategies. First, players should aim to be in contact with the ball for as little time as possible. A quick striking action with a solid point of contact needs to be a priority. After initial contact and through the separation of contact, players should continue their arm action through the serve in the same flight direction as the ball. These small strategies should allow players the greatest chance of creating a high velocity, zero rotational-velocity serve (Cairns, 2011).

Spin Serve

Upon making hand contact with the ball, there are two general results of the rotation on the impending serve. More often than not, the contact made by the hand
causes some form of rotational velocity on the ball. The direction and force of this rotational velocity is commonly referred to as the spin on the ball. The rotational velocity, speed, and force are primarily determined by hand placement, force of contact, and follow through of the hand and wrist directly after contact. In addition to the many factors that contribute to spin serves, players vary self-tossing and jumping patterns that influence the angle at which the serve is made.

Serving players will often toss the ball higher into the air thus forcing themselves to jump off of the ground before making contact which increases the contact point of the serve. This increase in contact height causes a downward arcing effect on the ball which makes it more difficult for the receiving player to control. The varying point of contact, rotational velocity, and power of the spin serve are the most common factors that influence the success rate of this type of serve. This serve is an advanced form of skill that requires a high level of physical ability and coordination (Gozansky, 1983).

In order to predict the success of jump serves in elite level men’s volleyball, studies have been conducted to measure ball velocity, power production in the shoulder, and ball position in relation to the server’s body (Häyrinen et al., 2011). The most significant predictor of ball velocity was the toss performed by the server as well as the shoulder and arm power production during the seconds leading up to contact with the ball. Specifically, the toss of the server would either allow or disallow the server an optimal contact point which directly affected to power produced by the shoulder. Additionally, the location and timing of the server’s toss directly affected the kinetic
movement patterns of the hip and core, thus affecting the ball velocity (Häyrinen et al., 2011).

Lithio and Webb (2006) examine the effect of topspin serving strategies through the use of mathematical principals which help explain the downward force placed on volleyballs as players attempt to increase rotational velocity. It was determined that enough topspin applied to a serve can significantly reduce the amount of time a serve spends in the air, thus reducing the amount of time a receiving player has to successfully control the contact. It is also assumed that the spin as well as decreased air-time contributes to a receiving player’s inability to successfully judge where the ball will land, thus decreasing the likelihood of a successful reception.

Consistent with previous research, trunk rotation and core flexion seemed to have little effect on ball speed generation in the jump serve (Coleman, Benham, & Northcott, 1993). Though minimal significance was placed on trunk rotation and core development, it was seen that elbow and humerus extension played a significant role in the production of force and speed in serving strategies. In this sense, the jump serve mimics similar movement patterns as an attack or a spike, and is therefore commonly compared when discussing technical instruction. Similar to the study by Häyrinen, et al., (2011), it was also noted that the toss of the serve greatly affected the body positioning and line of approach of the serving player.

Research by Huang and Hu (2007) further adds to existing research that suggests jump-serve strategies maximize ball velocity and speed. In this study, height
of toss leading up to contact directly influences body velocity at takeoff, jump height, contact height, and vertical body displacement. All of these variables are said to increase ball velocity and speed which contributes to successful serving outcomes. Though jump-spin serves are noted to have higher values of velocity and speed than float serves, it is important to note that jump-float strategies offer servers greater ball velocity and speed than standing float serve strategies.

In an attempt to analyze the serving effectiveness of serve modes and speed, Moras et al. (2008) noted that the predominance of jump serves in elite level men’s volleyball greatly contributed to serving success strategies. It was also noted that these strategies are most often employed by elite level men, as elite level women more often utilize float serve strategies. Though success rates of jump serving strategies were found to be greater than the success rate of float serves, the speed and velocity of serves were too difficult to quantifiably measure based on the reception of serve.

Finally, researchers found that jump serving strategies most often resulted in actions that limited the opponent (López-Martinez & Palao, 2009). Additionally, the jump serve resulted in a high number of errors and points and was therefore considered a high-risk strategy. Though the production of a jump serve may lead to a difficult reception, the high risk of error often leads players into more practical serves, such as the float serve. In both cases, players exhibited a relatively equal amount of efficacy. One of the most pertinent findings of this study was that the location of serve (jump or float) more often determined the success level of the reception. Beach volleyball is a
two-person game so it is difficult to compare the results to a six-person game; however, the concept of serving between zones or through multiple zones is valuable insight.

**Mental Approach to Serving**

Choosing which type of serve to utilize is only part of the challenge that players are faced with. Once a specific strategy has been selected, a player must then successfully execute that service skill in a way that is difficult for the opposing team to receive. Along with pre-performance physical routines, players are encouraged to use cognitive strategies that will help mentally prepare them for success.

*Self Talk*

The use of self-talk can have a positive effect on the outcome of various closed skill actions. Tod, Thatcher, McGuigan, and Thatcher (2009) explored the effects of varying forms of self-talk on vertical jump performance. Using motivational self-talk, instructional self-talk, and neutral self-talk pre-performance techniques, the researchers collected and analyzed data results of 24 subjects. The results of the study displayed a correlation in the usage of self-talk with increased center of mass displacement and angular velocity of the knee. Using self-talk to increase one’s vertical jumping ability can therefore lead to greater angular velocity of jump serves.

*Self-Efficacy*

It is widely believed that increased levels of self-efficacy and confidence will lead to increased levels of performance. At the elite and intermediate levels, players who demonstrate higher levels of self-efficacy often display increased serving abilities (Kitsantas & Zimmerman, 2002). Elite volleyball players are not only more successful in
their performance, but they are also more cognitive in their approach to achieving that success.

Physical Approach to Serving

Similar to the way basketball players use pre-performance routines before shooting a free throw in basketball, the way bowlers count their steps before releasing the ball down the lane, or the way golfers use focus cues before making a put, volleyball players often utilize physical strategies to guide them through the process of serving.

As discussed earlier, the flight path of a serve is largely determined by the force of the hand that is placed on the ball at the point of contact. This force determines the amount of rotational velocity, the speed of the ball, and ultimately, the success of the serve. In order to place a consistent and desired amount of force, it is imperative that players are in control of their pre-serve routines. Though unique to each player, these routines are instructed by coaches throughout the player’s progression to elite level competition and are often very similar.

It is widely accepted that the primary determinant of a successful serve lies in player’s ability to consistently control his or her own toss. Considering all of the various modes of serves discussed above, it is important to note that players often employ a multitude of tosses that correspond with various serving strategies (USA Volleyball, 2012). Keeping in mind that serving is the only skill in volleyball in which a player is in direct control, it is easy to see that the execution of the toss is of the utmost importance.
Instructional Strategies and Coaches’ Roles

In elite-level volleyball, coaches often dictate which type of serve that players use. In addition to advising what type of serve to use, coaches also give instruction as to where a player should serve. Typically, each half of the volleyball court is split into six serving zones, which are determined by serving rotations (see Appendix A). Again, many situational factors contribute to how a coach may choose which serve and service area to instruct their player to serve. A coach’s confidence level in a player’s ability to successfully execute a specific serve may very well dictate which serve to choose.

Vargas-Tonsing, Warners, and Feltz (2003) examined the connection among volleyball player’s self-efficacy levels in relationship to coach’s efficacy levels through a study that analyzed 12 high school women’s volleyball teams. Athletes were given a number of efficacy tests that were then compared to their coach’s efficacy tests. The results yielded a positive relationship in the amount of coach’s efficacy regarding team’s potential success and the team’s efficacy levels. This research suggests that when coaches perceive their teams to have greater potential, their teams will also demonstrate higher levels of success. This knowledge will help coaches mentally prepare athletes when promoting team and individual confidence.

Not all coaches require that players follow specific serving strategies. Some coaches will often give suggestions or advice but ultimately allow players to choose their own serving strategy. This type of coaching can lead to increased performance through raising responsibility and awareness of the person being coached (Neale, Spencer-Arnell, & Wilson, 2009). Players are either rewarded or punished based on their own decisions,
rather than following through with a decision made by a coach.

Serve-Receive Strategies

When considering which types of serve may be best suited to maximize success, it is important to consider serve-receive strategies. Research suggests that new serves or variations of previously experienced serves may be more difficult to receive from opposing teams. As volleyball players prepare to receive the opposing team’s serve, many factors contribute to their decision making process. Previous experience, situational factors, expectations, and various other factors all contribute to how players respond to opposing team’s serves.

According to Papageorgiou and Spitzley (2003), it is very important to consider that there is no single serving strategy or technique that all players can execute to the same level or ability. Serving should be tailored to the individual considering physical strengths, skills, and abilities. With these factors in mind, several strategies are suggested to increase a server’s ability to accurately assess the receiving team’s weaknesses and exploit them. First, a server should consider both the number of players receiving the serve and also the ability of those players. Knowing in advance which players are skilled passers will help the server determine who to serve and how to serve them. A receiving team’s offensive strategy and rotation should also be taken into account so that a server can negatively influence the outcome of the receiving team’s plan of attack. Because this serve/serve receive action is so vital to the outcome of each point, it is very important to value the planning and scouting of opposing players and the way they receive serves. Finally, the goal of each serve should be to
force the receiving team to act out of their comfort zone and thereby increase the
serving team’s chances of defending the action of the receiving team (Papageorgiou &
Spitzley, 2003).

Using the Recognition-Primed Decision Model (RPD model) as a basis of understanding of how athletes perceive situational factors within competition, Macquet (2009) studied the behaviors of 7 elite male volleyball players during the course of an international qualifying match. Using this qualitative analysis of the game film in relation to player’s perceptions of situational cues, results indicated that players’ decision making was based on his ability to recognize typical situations and react based on previous experiences. These results reinforced the RPD model that suggests that a persons’ decision making will depend on his assessment of a situation and his chosen course of action (Macquet, 2009). This ability to accurately assess instantaneous developments throughout the course of a match can help players improve decision making skills in important situations as well as help them to prepare for upcoming competitions. Thus, if a player has had no previous experience with a given serve, he/she will be less likely to accurately react to the ball.

Summary

Although many competitive strategies contribute to both personal and team success, ultimately, a team’s probability of winning is increased through the utilization of effective serving strategies (McGown et al., 2001). Additionally, recent rule changes have mandated that points are awarded on each serve, as opposed to previous rules that stated only serving teams could earn points (USA Volleyball, 2012). With these rules in
mind, the fastest way to earn a point in a match is through a service ace. On the same note, the fastest way to lose a point is through a service error.

Given that the serve is the only contact in volleyball that is not directly influenced by a previous touch, it is extremely important that players and coaches dedicate a considerable amount of time in both the execution and strategy of this skill. Many factors contribute to serve receive strategies. Player strengths and weakness, reception formations, and score of the match are just a few of the factors that players and coaches consider while deciding which type of serve to utilize and the desired location of that serve. Many of these factors are immeasurable, as serve success can only be quantified based on the quality of the reception.

Many studies have attempted to predict serve success based on a number of factors. Serve speed, rotational velocity, and angular velocity are just some of the variables that have been studied as predictors of serve success. Though many of these studies helped contribute to player’s and coach’s strategies, there has been little research in regards to the intended locations of serves.
Chapter 3

METHODOLOGY

This investigation measured the results of various location-based serving strategies utilized in elite level collegiate women’s volleyball competition as they relate to serve-receive success. The purpose of this study was to measure the success rates of various serving location strategies. This chapter will describe the subjects, measures, design, and procedures that were used in this study.

Participants

Subjects were female, Division 1 women’s college volleyball players who participated in Big Sky Conference matches during the 2009-2012 seasons. The subjects performing the serves were female, Division 1 women’s college volleyball players. For the purposes of this study and subsequent statistical analysis, the observed serves were considered the data source. Serves were observed based on availability of collected game films. It was assumed that all serves at this level were performed with the intention of gaining optimal success for the serving team.

Measurements

Data was collected using obtained game films from CSU Sacramento. All matches were observed using DataVolley 2007 software. 120 serves to zones 1, 5, and 6 were analyzed (total of 360 serves). The result of each serve relative to serve location was the only variable taken into consideration for this study. Service aces were taken into consideration as they affected the receiving team’s ability to successfully earn a sideout. Service errors were not taken into consideration as they had no effect on
receiving ability and offered little insight toward location strategies. All serves were
given a score of 0, 1, 2, or 3. A score of 0 was given to a service ace, which resulted in
a serve receive error. A score of 1 was given to a reception that provided the
availability of 1 offensive attacker for the receiving team. A score of 2 was given to a
reception that provided the availability of 2 offensive attackers for the receiving team.
A score of 3 was given to a reception that provided the availability of 3 offensive
attackers for the receiving team.

It is important to note that serve zone location is consistent; however, the rating
of each serve is subject to subjectivity of the researcher. To help reduce the possibility
of experimental error, serve success was pre-quantified based on the interpretation of
the coaching staff at CSU Sacramento. Serves were then reanalyzed by the researcher
to determine if the measurements were consistent. Additionally, though the reception
quality of serves can be considered subjective, a chart which divides the court into
quality control zones was created (Appendix B) to help reduce levels of subjectivity.
Using this chart, the researcher was able to compare results to those of the coaching
staff at Sacramento State University. Of the 360 serves analyzed, 345 (96%) were rated
the exact same as the coaching staff.

Data Collection

Game films were obtained based on the accessibility as offered by the CSU
Sacramento coaching staff. No films were preselected. As mentioned above, a total of
120 serves to zones 1, 5, and 6 were analyzed for a total of 360 serves. Serves were
analyzed in the order of observation. Serves were given a numerical ranking of 0-3
based on the receiving team’s ability to control the serve to a pre-determined location (see Appendix B).

Data Analysis

Using the results of the observed data, a statistical analysis was performed to determine if there were significant differences in the reception success of service zones 1, 5, and 6. With an alpha level of 0.05, an analysis of variance (ANOVA) was used to help make sense of the findings. Once the ANOVA was used to determine the $F$ ratio, the Scheffe follow-up test was used to determine the critical value. After obtaining the critical value, comparisons of the observed means to zones 1, 5, and 6 were made to determine whether or not there were significant differences in the findings.
Chapter 4

RESULTS

As discussed earlier, each serve was first categorized according to the zone of reception (1, 5, or 6). After the zone of the serve was clearly identified, the quality of the reception was analyzed using the universal 0-3 passing scale (USA Volleyball, 2012). 120 serves to each zone were analyzed for a total of 360 serves. Table 1 shows the reception average of each zone.

Table 1.
Reception Average of Each Zone

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>Zone 6</th>
<th>Zone 5</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reception Average</td>
<td>2.11</td>
<td>2.34</td>
<td>2.18</td>
</tr>
<tr>
<td>n= 120</td>
<td>n= 120</td>
<td>n= 120</td>
<td>n= 360</td>
</tr>
</tbody>
</table>

The overall group average of 2.21 indicates that the observed data was representative of highly skilled volleyball players. To put it in volleyball terms, the receiving teams (in the observed matches) had an average of 2.21 out of a possible 3 offensive attackers available on each reception.

Though the overall average of serve reception was 2.21, some variation existed among the three zones. In order to determine whether or not the observed differences were significant, an analysis of variance was performed. Table 2 displays the results of this ANOVA.
Table 2.

**Summary of ANOVA**

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>3.47</td>
<td>2</td>
<td>1.74</td>
<td>3.87</td>
</tr>
<tr>
<td>Within</td>
<td>159.9</td>
<td>357</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>163.37</td>
<td>359</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where N = total number of serves, n = number of serves to each zone, k = number of zones, SS= sum of squares, df = degrees of freedom, MS = mean square

After finding the sum of squares (SS) and identifying the degrees of freedom (df) an F ratio of 3.87 was obtained. To determine if this F ratio of 3.87 is significant, a critical F value calculator was used. With an alpha level of 0.05 and df (2, 357) a critical F value of 3.0210 was found. The F value of 3.87 is larger than 3.0210, and thus the variation among the three zones can be considered significant.

**Follow up test**

After determining that the obtained F value of 3.87 was considered significant, it was important to use a follow-up test to identify if there existed a significant difference among the reception averages of the three zones. The follow-up test that was used was a Scheffe test. The Scheffe test allowed the differences of the means of the reception zones to be compared. Table 3 displays the differences among the means of the three reception zones.
Table 3.

<table>
<thead>
<tr>
<th>Difference Between Means</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 6 mean = 2.34</td>
<td>Zone 6-Zone 1 = .23</td>
</tr>
<tr>
<td>Zone 1 mean = 2.11</td>
<td>Zone 6-Zone 5 = .16</td>
</tr>
<tr>
<td>Zone 5 mean = 2.18</td>
<td>Zone 5-Zone 1 = .07</td>
</tr>
</tbody>
</table>

The Scheffe test yielded a critical difference of 0.21. Thus, any difference in the means of over 0.21 will indicate that there was a significant difference of the reception means. According to Table 3, only the difference between the reception means of zones 6 and 1 was considered significant. The Zone 6 serve reception average of 2.34 was 0.23 higher than the Zone 1 average of 2.11. Thus, it can be stated that there was a significant difference in the serve effectiveness of serves to Zone 1 in relationship to serve effectiveness to Zone 6.

Hypothesis number 1 predicted that serves to Zone 1 would be the most difficult to receive. Table 3 indicates that serves to Zone 1 were the most effective, as the mean of 2.11 was significantly lower than the reception means to Zones 5 and 6. Therefore, the null hypothesis is accepted.

Hypothesis number 2 predicted that serves to Zone 6 would be the easiest to receive. Table 3 indicates that serves to Zone 6 were received at an average score of 2.34, which, according to the ANOVA and the Scheffe follow-up test, was determined to be significantly easier than serves to Zone 1. Serves to Zone 5 were received at an average score of 2.18 which was not determined to be significantly different than the serves to Zones 1 or 6.
Chapter 5

DISCUSSION

As discussed in Chapter 3, each analyzed serve was given a score of 0-3 based on the quality of the reception in relation to the coding chart. Though the averages of the serves were analyzed in Chapter 4, there existed several pertinent observations upon taking a closer look. Table 4 shows the total amount of “0,” “1,” “2,” and “3” serves.

Table 4.
Total Number of "0," "1," "2," and "3" Serves by Zone

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>&quot;0&quot; pass</th>
<th>&quot;1&quot; pass</th>
<th>&quot;2&quot; pass</th>
<th>&quot;3&quot; pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 6</td>
<td>0</td>
<td>19</td>
<td>69</td>
<td>32</td>
</tr>
<tr>
<td>Zone 5</td>
<td>2</td>
<td>8</td>
<td>57</td>
<td>53</td>
</tr>
<tr>
<td>Totals</td>
<td>2</td>
<td>46</td>
<td>187</td>
<td>125</td>
</tr>
</tbody>
</table>

In observing elite level volleyball, it was not surprising to find that most receptions qualified as “2” passes. Again, the “number” of the pass corresponds to the number of attackers that a receiving team will have available to use as a result of the pass. Thus, the majority of serves resulted in the receiving team having 2 attackers available to use during offensive strategies.

To further prove the quality of observed play, out of 360 total serves, 312 were quantified as a “2” or a “3,” while only 48 were quantified as “1” or “0.” The number of “0” passes (2) should be considered atypical with a total sample size of 360.

Additionally, though only 2 service aces were recorded, it is important to consider why both occurred in zone 6. It is possible that serving across zones causes confusion among receiving players, thus resulting in an increased number of aces. Due to the fact
that players in zone 6 have teammates receiving on either side of them, the likelihood of reception confusion is increased.

On a related note, “seams” exist between zones as players fluctuate between various reception strategies. These seams are depended on player positioning and are not consistent. Players in zone 1 and 5 only have one “seem” to be concerned with, though players in zone 6 have two “seems” to consider. The presence of these “seems” contributes to reception confusion, which can also affect the quality of the reception.

As hypothesis 2 predicted, serves to zone 6 were the easiest serves to receive. Considering the physical location of zone 6 relative to the quality reception-coding chart (Appendix 2), it is clear that serves to zone 6 require serve receivers to pass the ball in a direct line toward the setter. Not only is the direction of the pass a straight line, but the distance traveled from passer to setter is much shorter than the distance from a passer in zone 5 or zone 1.

In a sport where many matches are won and lost by just a handful of points, this information will prove extremely useful for coaches and players. This study suggests that it is possible that a “default serving zone” may exist. If this is true, coaches and players can exploit serve-receiving weakness at a higher rate, which would lead to a higher predictability of success.

An important fact to consider is that volleyball, as a sport, is largely a tournament-based sport where teams can potentially face several opponents in one day. Because of this, it is often difficult to identify team and individual weaknesses to exploit. If coaches and players know that there is a specific zone that may lead to
greater success over the course of a long tournament day, they will hold a serious advantage over other teams. Such knowledge can save coaches and players a large amount of scouting and game-planning, which often takes a considerable amount of time and energy.

Recommendations for Future Research

The primary purpose of this study was to determine if there was a significant difference among the quality of serves to zones 1, 5, and 6. In order to measure these hypotheses, serves were observed and quantified based on the quality of the reception. It was found that serves to zone 1 were significantly more difficult to receive than serves to zone 6. Also, in this study, serves to zone 5 were found to be easier to receive than serves to zone 1 (though according to the analysis of variance, not at significant levels).

For future research, it would be beneficial to further research this topic and investigate why serves to zone 1 were the most difficult to receive. For example, it can be theorized that the fact that most team’s setters are right-handed, which creates reception problems for passers located in zone 1. The angle of the pass can be difficult to receive by setters and could therefore contribute to poor reception patterns.

Many players and coaches also agree that spin serves without a considerable amount of force are actually easier to receive for passers as the flight of the ball follows a predictable path (albeit at higher speeds) as opposed to float serves which follow unpredictable patterns of flight. It would be helpful to investigate if there is a speed threshold at which point spin serves become increasingly more difficult to receive.
Finally, as indicated in Chapter 3, many variables such as serving location (in relation to the service line), match score, importance or timing of match, reception strategies, and player skill or previous success all largely influence the quality of serve and impending reception. Any of these variables could be studied at more length to add to the existing body of knowledge surrounding serve success.
APPENDICES
### APPENDIX A

Base Serve Reception Zones

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>Zone 6</th>
<th>Zone 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 2</td>
<td>Zone 3</td>
<td>Zone 4</td>
</tr>
<tr>
<td>Net</td>
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</tr>
<tr>
<td>Zone 4</td>
<td>Zone 3</td>
<td>Zone 2</td>
</tr>
<tr>
<td>Zone 5</td>
<td>Zone 6</td>
<td>Zone 1</td>
</tr>
</tbody>
</table>
### APPENDIX B

**Standard Serve Reception Pass Coding**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>2</th>
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<tbody>
<tr>
<td>1</td>
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REFERENCES


