How Technology Changed the NBA

In 2014, Steve Kerr took over as the head coach for the Golden State Warriors ("Steve Kerr"). Prior to his coaching career, Kerr was known for being a deadly three-point shooter and famously knocking down the game-winning jump shot in the 1997 NBA Finals to clinch the fifth championship for teammate Michael Jordan ("Steve Kerr"). Kerr holds the record for best career three-point percentage in NBA history ("Basketball Statistics"). So, what happened when the most potent three-point shooter in league history took over as a head coach? His Golden State Warriors won more games in a three-year span (2014-2016) than any other team in NBA history, while claiming two championships along the way (Young). Led by Kerr's philosophy, they attempted more three-point shots during those three years than any other team in league history ("Basketball Statistics"). The Warriors' success has caused many teams to mimic their strategy, putting up record numbers of three-point shots. During the 2016-2017 season, NBA teams shot twenty seven three-pointers per game--a number that has increased by almost ten shots in the last five years and is the highest in league history ("Basketball Statistics"). However, as Toronto Raptors' head coach Dwane Casey notes, teams can "shoot as many 3s as you'd like, but if you don't make them, that philosophy goes out the window" ("Lights, Cameras, Revolution"). What if I told you that it is improved technology in basketball that has resulted in players shooting more three-pointers than ever before? But, this technology has done more than just increase the number of three-point attempts. The advancement of technology in basketball has resulted in a massive influx of three-point shots, having a cascading effect on other aspects of the NBA, changing how the game is played and coached.

The Technology

How is it that technology is able to affect such a simple game? Video technology and player-location tracking data allows shooting technique to be broken down like never before. College and NBA programs have the technology to use video to track shooting calculations such as the shooter's elbow angle, the shooter's release point and time, the velocity of the ball leaving the hand, the rotation of the ball, the trajectory of the shot, and the height of the player's jump while he shoots (McCann). One specific video and tracking program is SportVU, originally created for military missile tracking and is now available to every NBA team (Plafke). SportVU uses cameras synched with complex algorithms to track the x, y, and z positioning data for all eleven objects on the court-the five players on each team and the ball (McCann). With this data, the player's shot can be broken down piece by piece, seeing what works and what does nott. For example, a player can look at the height of his jump on made shots verses missed shots, and adjust his form accordingly. Chelsy Ranard notes that technology offers "a mirrored look back that makes coaches able to show players a reference for what they need from them that has revolutionized training" ("Technology Changing Coaching"). While there is no "perfect" shot form, shooting coaches can use of all this information to determine the most effective shooting style for each player. For example, the average NBA player releases his shot with a 45-degree trajectory, while Stephen Curry releases his shot between 50 and 55 degrees ("Sport Science: Stephen Curry"). Standing five inches below the league average, Curry adjusted his shot trajectory when he entered the league in an effort to more effectively get his shot off while being guarded by taller defenders ("Sport Science: Stephen Curry"). With advanced video and tracking technology, it is easy to notice flaws in technique and inconsistencies in form, enabling today's NBA player to fine-tune his jump shot more thoroughly than ever before.

While high-tech video analysis and position tracking such as SportVU is only available at the college and professional levels, there is a free app on the App Store that allows coaches to view and critique video sent in by their players ("Ubersense"). The app is called Hudl Technique by Ubersense, Inc., and it is used by middle and high school coaches around the nation to assist individual players with their form and technique ("Ubersense"). All the player has to do is record himself shooting several jump shots and send the coach the video clip via the app. The coach is then able to view the jump shot in slow motion, using drawing tools and audio recording to evaluate the player's technique. The coach can send the edited video, complete with instructive markings and the audio recording of the coach's evaluation and pointers, back to the player. Panopto, a video platform for universities, says that due to "recent improvements in video technology… it (is) easier and more affordable than ever for just about any coaching staff to show specific moments and movements where players may be able to improve" ("Athletics Departments Use Video to Help Athletes"). At every level of the game, basketball players are benefitting from video technology to receive improved jump shot training.

Another piece of technology that is changing basketball is the automated rebounding machine. These machines consist of a large net surrounding the basket to catch rebounds, draining the balls into an electric passing machine that launches the ball back to the player. Not only does this enable the player to shoot endlessly without having to chase rebounds, but the rebounding nets force the shooter to put proper arc on the shot ("The Gun 10K"). The machine can be set to pass the ball back to the same spot or multiple spots. The most prevalent of these machines is The Gun by Shoot-a-way ("The Gun 10K"). The Gun boasts that a player can shoot

up to 1,800 shots in one hour using the machine ("The Gun 10K"). Shoot-a-way also has an app that records and stores data from each shooting zone on the court. These machines are seen in almost every high school, college, and NBA gym across the United States. When I played high school basketball, I would come to the gym in the morning before school and use The Gun. I could put up hundreds of shots without the assistance of another player or a coach. In just three months, I saw my three-point make percentage increase by a drastic 10%. Micah Mason, from Duquesne College, grew up shooting with The Gun in his backyard ("College Basketball's Best Shooter"). After years of shooting and thousands upon thousands of shots, Mason proved himself the best three-point shooter in the nation from 2013-2015 ("College Basketball's Best Shooter"). Mason made 46.35% of his career three-point attempts, the fourth best percentage in NCAA history ("Basketball Statistics"). Rebounding machines assist shooters in putting up vastly more shots in a workout than previously possible.

Analytics is the systematic computational analysis of data or statistics ("Beyond 'Moneyball'"). With the increase in technology in the last ten years, analytics have found a large

role in sports (Shea). Experts Benjamin Alamar and Vijay Nehrotra define sports analytics as "the management of structured historical data, the application of predictive analytic models that utilize that data, and the use of information systems to inform decision makers and enable them to help their organizations in gaining a competitive advantage on the field of play" ("Beyond 'Moneyball'"). With new spatial tracking technology like SportVU, more analytical data is available than ever before (McCann). SportVU can record data such as shooting percentages at different areas around the three-point arc, shooting percentages off the dribble versus off the pass, and the average distance between the shooter and the defender (McCann). Analytics rely on efficiency to gain a competitive edge, and when it comes to scoring, that means finding the most effective way to score as many points as possible (Shea). So, what are the most efficient shots on the court? The mathematical answer seems easy-three points are more than two. However, it isn't quite that simple. The further a player is from the basket, the smaller the chance the ball has to go in, thus making shots under the basket most successful and three-pointers least successful. Does the extra point make up for the smaller likelihood of making a three-point shot? If a team attempted the same number of each shot, the team can make just 33% of their three-pointers and score the same number of points as they would if they made 50% from the two-point area (Lenz). Since 1980, NBA players have made approximately 48% of their two-point shots, meaning that two-pointers result in roughly 0.96 point per attempted shot (Denton). In each year since 1995, the NBA league-wide shooting percentage from three-point range has exceeded 33%, analytically giving three-pointers more value per attempt and thus making them the more efficient shot (Denton). Wade McCagh argues that "it took the most advanced spatial tracking technology we've seen in sports to reveal a simple truth: 3 points are more than 2" ("Spatial Analytics"). Within the last ten years, the emergence of technology capable of recording

complex analytical data has resulted in teams shifting towards a more analytic-based strategy, for both in-game and personnel decisions.

The Technology Effect

From 1950 to 1978, the three-point line did not exist in the NBA ("The History of the 3-Pointer"). The game was played under the basket, controlled by the game's tallest players. During the twenty-three NBA seasons in which the three-point line did not exist and an MVP was awarded, twenty-one of the twenty-three league MVP awards were given to a player who was at least 6'7" and played either the center or the power forward position ("Basketball Statistics"). The game was dominated by 6'10" Bill Russell, 7'1" Wilt Chamberlain, and 7'2" Kareem Abdul-Jabar ("Disappearance Of Traditional NBA Big Man"). These players combined to win nineteen NBA championships and fifteen MVP awards ("Basketball Statistics"). Prior to the 1979 season, the NBA made the decision to institute the three-point arc ("The History of the 3-Pointer"). It was not welcomed warmly, with many people considering it a "gimmick" and not real basketball (Mather). In fact, John MacLeod, head coach of the Phoenix Suns at the time, said, "I'm not going to set up plays for guys to bomb from 23 feet. I think that's very boring basketball" ("Gimmick to Game Changer"). In the first season of the three pointer, NBA teams shot only 2.8 threes per game ("Basketball Statistics"). It was not until 1994, fifteen years after the inaugural season, that the league-wide number of three-point attempts per game reached double digits ("Basketball Statistics"). Coaches did not put a strong emphasis on three-pointers, and players struggled to shoot the long ball successfully (Hersch, Galileo). Three-pointers were only taken if they were wide open or in late game situations. However, the 2000s rolled around and the three-ball, led by sharp shooters Ray Allen and Steve Nash, was gaining momentum

(Denton). But still, the majority of the league could only make around 30% of their shots from deep, making the the shot inefficient and mostly ineffective ("Basketball Statistics").

Basketball trainer Rich Stoner emphasizes consistency and repetition as the two most important keys to shooting a basketball ("Basketball Training"). The first rebounding machine that could pass the ball back to the shooter was released in 1999 ("The Gun 10K"). Rebounding machines made it possible for NBA players to get more shooting repetitions than ever before, branding the muscle memory into their brains ("The Gun 10K"). Not only were players getting more repetitions than ever before, but with the use of video technology, they were able to review and analyze their shots, ensuring that their form was consistent (Ranard). The technology of the 2000s brought players the ability to train more efficiently than previously possible. Repetitions increased, consistency grew, and subsequently, the three-pointer was shot more accurately. From 2003 to 2008, the league-wide three-point success rate increased each year, reaching a new league record in 2008 at 36.7% ("Basketball Statistics"). All seven of the league's highest three-point shooting percentage seasons occurred after 2007 ("Basketball Statistics"). With the use of technology in shot training, the NBA began shooting the three-pointer more accurately than ever before.

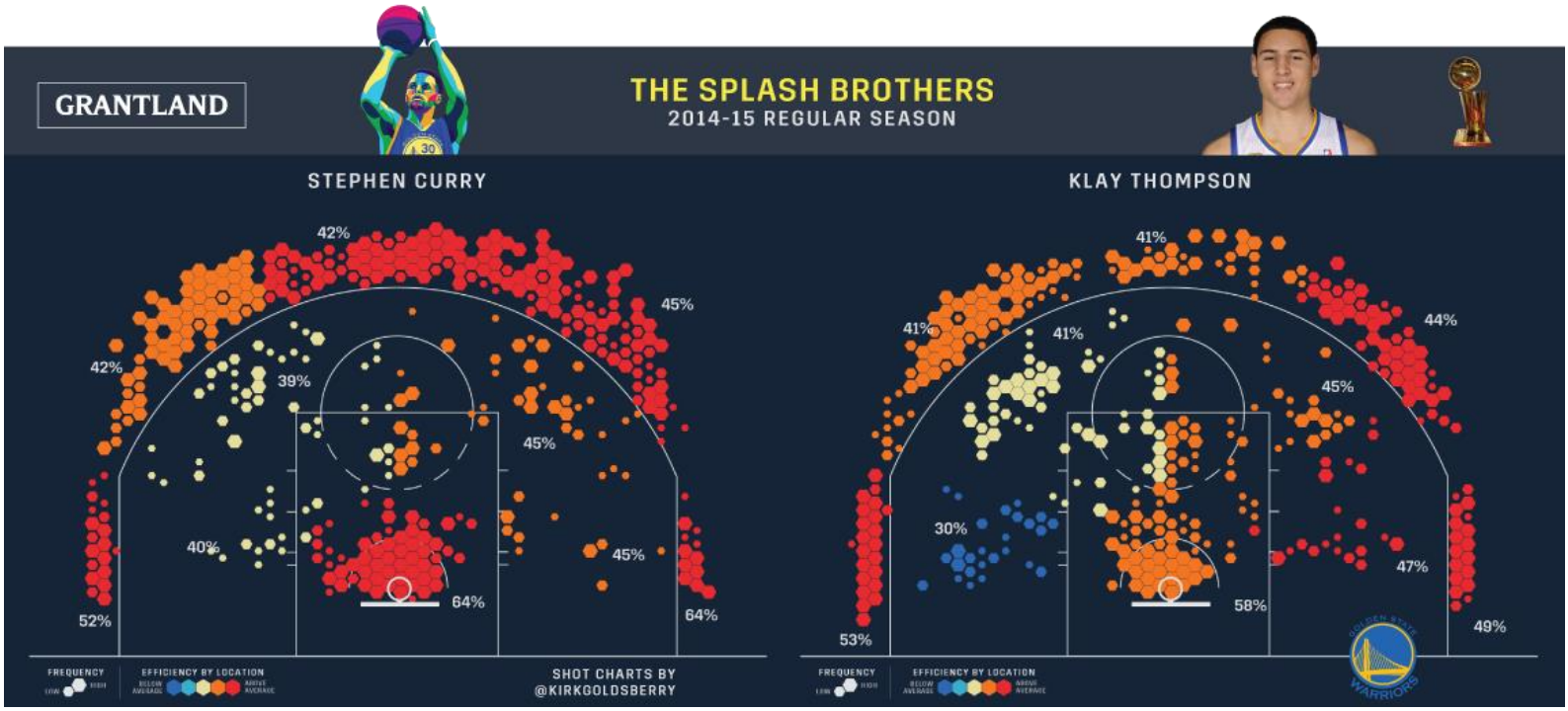
In 2009, SportVU was first used in the NBA, but only by four teams (McCann). When SportVU was put to use, it revealed that with NBA players' improved shooting percentage, the three-point shot was analytically more efficient than a two (Lowe). While some teams valued analytics more than others, the Golden State Warriors bought in all the way, drafting three-point shooters Stephen Curry and Klay Thompson (Wagner). By the start of the 2012 season, SportVU was installed in all thirty NBA arenas (McCann). For the first time in NBA history, the league reached 20.0 three-point attempts per game in the 2012 season ("Basketball Statistics"). In 2014,

the Warriors took the league by storm, embracing the analytical philosophy of coach Steve Kerr and shooting 27.0 three-pointers per game on the way to their first NBA championship ("Steve Kerr"). In 2016, league-wide three-point attempts per game skyrocketed to 27.0 ("Basketball Statistics"). From 2011 to 2016, the NBA's average number of three-point attempts per game increased by an astonishing nine shots ("Basketball Statistics"). The league's three-point records have been obliterated each of the last six seasons. The NBA is changed. The big man no longer reigns supreme; it is a shooter's league. The best teams in the league shoot and make the most three-pointers. Technological innovations have resulted in players shooting more accurately than ever before, and as analytical data is revealed, coaches are instructing their players to keep letting the long ball fly. Technology is changing more than just the number of three-pointers attempted and made, as an increased number of threes has a cascading affect and has changed other parts of the NBA game.

The Changes

With NBA players shooting and making three-pointers at a historic rate, advanced analytics have determined that the mid-range jumper is the least efficient shot in the game, causing mid-range shot attempts to plummet. With the increased threat of three-pointers, defenses are forced to defend the perimeter tighter than ever before, allowing space for open drives to the basket (Hersch, Galileo). The offensive player's goal is to either shoot a three-pointer or beat his defender to the basket. A mid-range jumper is a jump shot taken between the paint and the three-point line, usually between 16 and 23 feet (McCagh). The league averages roughly 38% on shots taken in the mid-range area, while connecting on 35% of shots from three land ("Death of Mid-Range"). No player wants to attempt a two-point shot that has nearly the same likelihood of scoring as a three-point shot that is just a few steps further back. Analytical

calculations have deemed the mid-range shot as the least efficient shot on the floor, while layups



and threes are the most efficient (McCagh). Since 2009, the league-wide number of mid-range jumpers has dropped each year, while three-point attempts and makes have increased each year (Young). Grantland shows a shot chart for Stephen Curry and Klay Thompson from the 2014-2015 season, with larger dots showing more frequency, red dots being the most efficient, and blue dots being the least efficient. The Splash Brothers almost completely eliminated mid-range shots from their game on their way to an NBA title, as three-pointers and layups proved to be more efficient. By posing a greater threat from the three-point line, offenses are able to space out the defense, increasing the number of three-point shots and layups, while minimizing the analytically-inefficient mid-range jumpers.

Video technology, rebounding machines, and complex analytics have driven the traditional NBA big man into extinction. Before NBA players were able to shoot the three-pointer with enough accuracy to make it a dangerous threat, the game was played inside-out

("Disappearance of Traditional NBA Big Man"). This means that the team's first priority was to pound the ball inside to their big man. The center played with his back to the basket, and specialized in post moves such as the drop step or jump hook (Kier). The traditional NBA center could be described as tall, bulky, and lumbering, while grabbing rebounds and guarding the rim. But, three-point success has changed how offenses attack. In today's NBA, teams space the floor as much as possible around the three-point arc, forcing big men to come out and play perimeter defense and giving them fewer interior scoring opportunities on offense ("Disappearance Of Traditional NBA Big Man"). As a result of this changing playing style, centers are seeing a decrease in value and playing time. In 2016, only nine centers averaged more than thirty minutes played per game, compared to twenty-one point guards ("Basketball Statistics"). The Warriors have won two NBA championships by spacing the floor and playing "small-ball" without a traditional center ("Big Men"). Kevin O'Connor predicts that "as more teams copy the Warriors' style of play, we'll see more teams going small" ("Big Men"). The last center to win the MVP award was Tim Duncan in 2003 ("Basketball Statistics"). It has been years since the NBA has seen a dominant traditional center. Memories of big men controlling the court are just that- memories. Spencer Kier credits diminishing dominant post play "to the clear advantages that athleticism has over opposing post presences, as an overwhelming amount of speed and explosiveness is beginning to trump dominance in the paint" ("Death of the Traditional Big Man"). Many teams are instead valuing more athletic power forwards, such as Anthony Davis, Giannis Antetokounmpo, and Kristaps Porzingis, who have the ability to space and the floor, handle the ball, and shoot from three ("Disappearance Of Traditional NBA Big Man"). Three-point shooting success has completely shifted the center position from the focal point of the

offense to an undervalued afterthought, resulting in the disappearance of the traditional NBA big man.

The technology innovations that have resulted in a massive influx of three-pointers into the NBA game have made it possible for players without dominating athletic ability to dictate the game, affecting how teams make game-time and personnel decisions. The league's best team entering the 2017 season is the Golden State Warriors, led by "Splash Brothers" Stephen Currry and Klay Thomson ("Steve Kerr"). Curry, two time MVP and one of the most prolific shooters of all time, owns the top three spots in the record book for three pointers made in a season ("Basketball Statistics"). However, when he was coming out of Davidson College, NBA scouts expressed that Curry was "far below (the) NBA standard in regard to explosiveness and athleticism" and that "due to his size and physical attributes… he's not a natural point guard that an NBA team can rely on to run a team" ("Stephen Curry-NBADraft"). Golden State, one of the earliest proponents of analytics, chose to draft Curry for the weapon that his three-point shooting accuracy provided (Powell). A player's three-point shooting ability now affects all team decision making, from drafting to signing free agents to in-game decisions (Lowe). Prior to the three-point revolution, NBA teams traditionally attempted to win with superior athleticism and physicality, but Hank Hersch recognizes that "the ability to shoot, a trait that for a time seemed to rank third behind quickness and power, has become a much more valued commodity" (Galileo). While much of basketball is dictated by athleticism, if a player can consistently make three-pointers, no matter what their physical ability may be, they can be effective. This has made way for a new type of player: the three-point specialist. These are players who are usually only on the court to shoot threes, while they may be a liability in other aspects of the game ("Basketball Statistics"). Three-point specialists such as Kyle Korver, JJ Redick, and Danny

Green lack the athleticism that much of the NBA has, but have been great contributors to their teams by way of the long ball ("Basketball Statistics"). For example, Korver stands at 6'7" but has dunked merely twenty-four times during his fifteen-year NBA career, as he spends the majority of his time on the court prowling around the three-point arc (Martin). The increase in the use of technology in basketball has changed how teams evaluate talent, forcing owners and coaches to decide whether to value size, athleticism, or shooting ability more when making personnel decisions. Modern basketball analytics are resulting in coaches valuing three-point shooting ability now more than they did fifteen to twenty-five years ago.

The Summary

Technology has completely changed the way the NBA game is played. With video technology and rebounding machines, players are better three-point shooters than ever before ("Technology Impacting Future of Basketball"). As players' shots have improved, analytical calculations suggest taking more three-pointers (McCagh). These factors have resulted in coaches instructing players to shoot threes at incredibly high rates. The increased volume of three-point attempts and the players' improved accuracy has subsequently had a cascading effect on other phases of the game. The number of mid-range jump shots is being minimized, as players aim to shoot the analytically more efficient shots from three or near the basket ("Death of Mid-Range"). Due to the spaced floor, the traditional NBA center is no longer the centerpiece of the game, but rather has been diminished to a shadow of the position's former usage and value. The three-point shot has introduced the ability of players to be pivotal to their team without dominating athleticism, and has changed how teams and coaches assess talent. The NBA is a very different league than it was twenty to thirty years ago, all stemming from the technological innovations that have enabled players to shoot more accurately from three-point land than ever

before. The message to the NBA is clear: get with the three ball or get out, because the game has changed.

Works Cited

"Basketball Statistics and History." *Basketball-Reference.com*, www.basketball-reference.com/.

"Beyond 'Moneyball': Rapidly Evolving World of Sports Analytics, Part I." *Analytics Magazine*, 14 July 2016, analytics-magazine.org/beyond-moneyball-the-rapidly-evolving-world-of-sports-analytics-part-i/.

Burns, Jim. "Rise and Fire: The Origins, Science, and Evolution of the Jump Shot—And How It Transformed Basketball Forever." *Library Journal*, vol. 140, no. 19, 15 Nov. 2015, p. 89. EBSCO*host*, proxy-remote.galib.uga.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=110786703&site=ehost-live.

"College Basketball's Best Shooter: Micah Mason." YouTube, 18 Aug. 2015, www.youtube.com/watch?v=7ZBlaDohKD4&list=PLxUUcqfTjMYPkF3tgGVlGbc4dadypR3uo&index=2.

"Death of the Mid-Range Jumper. . .statistically Speaking." *Krossover.com*, Krossover, www.krossover.com/articles/death-of-the-mid-range-jumper-statistically-speaking/.

Denton, John. "The 3-Point Shot More Valuable Than Ever Before." *NBA.com*, 23 Jan. 2017, www.nba.com/magic/news/3-point-shot-more-valuable-ever-20170123.

"Disappearance Of The Traditional NBA Big Man." *ThePostGame*, 19 June 2012, www.thepostgame.com/blog/eye-performance/201206/nba-centers-big-man-clifford-ray-kareem-ewing-howard-mikan-wilt.

"The Gun 10K." *Shoot-A-Way*, shootaway.com/the-gun-10k/.

Hersch, Hank. "LET THREEDOM RING the Three-Point Shot, Now Grudgingly Accepted by Coaches, Has Changed the College Game." *Sports Illustrated*, vol. 72, no. 6, 12 Feb.

1990, p. 68. EBSCO*host*, proxy-remote.galib.uga.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=57927029&site=ehost-live.

"The History of the 3-Pointer." *USA Basketball-The History of the 3-Pointer*, www.usab.com/youth/news/2011/06/the-history-of-the-3-pointer.aspx.

"How Athletics Departments Can Use University Video to Help Athletes." *Panopto Video Platform*, Panopto, 12 Aug. 2016, www.panopto.com/blog/how-athletics-departments-can-use-their-universitys-video-platform-to-help-their-athletes-get-a-step-ahead/.

"How the Advances of Technology Are Impacting the Future of Basketball." *TechCo*, 3 Oct. 2015, tech.co/advances-technology-impacting-future-basketball-2015-10.

Kier, Spencer. "The Death of the Traditional Big Man in the Evolving NBA Landscape." *Bleacher Report*, Bleacher Report, 4 Apr. 2017, bleacherreport.com/articles/1200804-the-evolving-nba-landscape-and-the-death-of-the-traditional-big-man.

Lenz, Dan. "What the Three-Point Shot Can Do for You." *Coach & Athletic Director*, vol. 67, no. 2, Sept. 1997, p. 24. EBSCOhost, proxy-remote.galib.uga.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=9710061694&site=ehost-live.

Lowe, Zach. "Lights, Cameras, Revolution." *Grantland*, 19 Mar. 2013, grantland.com/features/the-toronto-raptors-sportvu-cameras-nba-analytical-revolution/.

Martin, Josh. "Three-Point Specialists Rule the NBA." *Bleacher Report*, Bleacher Report, 11 Apr. 2017, bleacherreport.com/articles/1559265-three-point-specialists-are-ruling-the-nba.

Mather, Victor. "How the N.B.A. 3-Point Shot Went From Gimmick to Game Changer." *The*

New York Times, The New York Times, 20 Jan. 2016, www.nytimes.com/2016/01/21/sports/basketball/how-the-nba-3-point-shot-went-from-gimmick-to-game-changer.html.

McCagh, Wade. "How Spatial Analytics Killed The Mid-Range Jump Shot." *Sports*, Vice, 25 Sept. 2016, sports.vice.com/en_au/article/pgj338/numbers-game-how-spatial-analytics-killed-the-mid-range-jump-shot.

McCann, Zach. "Player Tracking Transforming NBA Analytics." *ESPN*, ESPN Internet Ventures, 19 May 2012, www.espn.com/blog/playbook/tech/post/_/id/492/492.

O'Connor, Kevin. "Big Men Are the New Running Backs in NBA Draft." *SBNation.com*, SBNation.com, 13 June 2016, www.sbnation.com/nba/2016/6/13/11916952/jakob-poeltl-big-men-nba-draft-2016.

Plafke, James. "How the NBA's SportVU Ball and Player Tracking Tech Changes the Face of Sports." *ExtremeTech*, 29 Oct. 2013, www.extremetech.com/extreme/169775-how-the-nbas-sportvu-ball-and-player-tracking-tech-changes-the-face-of-sports.

Powell, Shaun. "Doubt, Disdain Marked Most NBA Teams' First Forays into 3-Point Land." *NBA.com*, NBA.com, 21 Feb. 2017, www.nba.com/article/2017/02/21/history-3-pointer-evolution-nba-game-larry-bird-stephen-curry-james-harden.

Ranard, Chelsy. "How Technology Has Changed Coaching." *WorkInSports*, www.workinsports.com/blog/how-technology-has-changed-coaching/.

Shea, Stephen. "Basketball Analytics." *Basketball Analytics*, 17 July 2017, www.basketballanalyticsbook.com/.

"Sport Science: Stephen Curry." YouTube, 25 May 2013, https://www.youtube.com/watch?v=HOiH1eVCggw.

Stephen Curry | NBADraft.net, NBADraft, www.nbadraft.net/players/stephen-curry.

"Steve Kerr." *Golden State Warriors*, NBA.com, 9 Feb. 2016, www.nba.com/warriors/staff/steve-kerr.

Stoner, Rich. "Basketball Training: Skills, Speed, and Strength." *Rich Stoner Training*, www.richstoner.com/.

"Ubersense: A Must-Have App to Analyse Shooting Form." *Basketball For Coaches*, 7 Apr. 2013, www.basketballforcoaches.com/ubersense/.

Wagner, Kyle. "Basketball's Other 3-Point Revolution." *FiveThirtyEight*, FiveThirtyEight, 27 Jan. 2017, fivethirtyeight.com/features/basketballs-other-3-point-revolution/.

Young, Shane. "The NBA's 3-Point Revolution." *BBALLBREAKDOWN*, 16 Dec. 2016, bballbreakdown.com/2016/12/16/the-nba-3-point-revolution/.