

The Effect of Stroboscopic Training on the Ability to Catch and Field

by

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## ABSTRACT

Across a wide variety of sports, our visual abilities have been proven to profoundly impact performance. Numerous studies have examined the effects of visual training in athletes and have found supporting evidence that performance can be enhanced through vision training. The present case study aimed to expand on research in the field of stroboscopic visual training. To do so, twelve softball players, half novice and half expert, took part in this study. Six underwent a four-week stroboscopic training program and six underwent a four-week non-stroboscopic training program. The quantitative data collected in this case study showed that training group (stroboscopic vs. non-stroboscopic) and skill level (novice vs expert) of each softball player were significant factors that contributed to how much their fielding performance increased. Qualitative data collected in this study support these findings as well as players' subjective reports that their visual and perceptual skills had increased. Players trained in the stroboscopic group reported that they felt like they could "focus" on the ball better and "predict" where the ball would be. Future research should examine more participants across a longer training period and determine if more data would yield even greater significance for stroboscopic training.

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## INTRODUCTION

One of the most common phrases stated in sports is “keep your eye on the ball.” This key phrase demonstrates that the visual system is an essential component of the sensory system utilized in sports performance. The relationship between good eyesight and skill level have been prominent since 1921 when Columbia University researchers examined Babe Ruth’s vision. According to sports vision specialist, Dr. Bill Harrison, Ruth was considered the Home Run King because he was the best on the field with regards to vision (Baxter, 2007). With Columbia University, Fuchs (2009) assessed Ruth’s sensory-motor and cognitive skills using standard laboratory procedures for studying attention, reaction time, and sensory-motor coordination. To assess Ruth’s coordination, Ruth was asked to tap a metal plate as rapidly as possible with a stylus to determine the number of taps he made within one minute (Fuchs, 2009). Ruth’s performance was superior, making 193 taps with his right hand and 176 with his left. A comparison group only performed an average of 180 taps. Additionally, Ruth was tested on his ability to recognize letters that flashed for a brief moment. His performance again was superior as he identified an average of 6 letters from an array of 8, while a comparison group only remembered 4.5 (Fuchs, 2009). It was concluded that Ruth’s vision worked about 12% faster than those of an average person (Baxter, 2007). The Home Run King shows us how important visual abilities are in sports performance.

Additionally, the American Optometric Association’s Sports Vision Section is a strong advocate for vision being a critical attribute for optimal performance in sports (Horn, Edmunds, & Daniels, n.d.). Illustrated in the movie, *Major League*, the experience of baseball pitcher Ricky Vaughn provides a notable example of the interaction between

vision and sports. For example, a 99-mph fastball doesn't mean much if you can't see it well enough to hit it or catch it (Horn, Edmunds, & Daniels, n.d.). How are athletes able to track a ball coming in at such high velocities? Is an athlete's visual performance trainable or is it something they are born with? The ability to see a ball is an important skill all athletes desire in order to have optimal performance in their sport. To further understand this topic, this study hypothesized that stroboscopic training will impact softball/baseball players' performance level for fielding a ground ball. Stroboscopic training is characterized by glasses that alternate between transparent and opaque lens. This generates a blinking effect that reduces contrast and forces the visual system to operate in difficult conditions, making it more challenging to do balance and reaction drills such as fielding a ground ball. Stroboscopic training is hypothesized to improve eye-hand reaction times, improve visual span, increase peripheral awareness, develop visualization techniques and increase dynamic visual acuity.

## LITERATURE REVIEW

Many training methods across multiple sports have been proposed to aid performance through visual training. Situations in which vision places an extreme demand on visual processing include a baseball player at bat who must determine the spin and location of the pitch, a hockey goalie who must determine the location and speed of the puck, and a football player who must estimate the trajectory of the football. Although we recognize how vision plays an essential role in sports performance, athletes typically only train their muscles, strategies, and understanding of the game, (Smith & Mitroff, 2012). Due to the strong relationship between vision and sports performance, previous research has reported several important connections, (Smith & Mitroff, 2012). The

literature presented here examines those connections and how visual abilities are enhanced through visual training.

Research by Tate and colleagues (2008) sought to investigate the influence of specific visual training programs on batting performance of cricket players. Results from this study showed a statistically significant improvement in all visual skills tested in the experimental group. Inclusive, Tate found that visual skills training programs can improve basic skills such as reaction time, depth perception, and saccadic eye movements. The improvements reported for basic skills correlate to an increase in batting performance for cricket players. These findings provide evidence that may be applicable to athletes who undergo training in other sports. In addition to supporting the current case study, the information found by Tate and colleagues contributes to the future of sports and how optimal performance can be achieved.

Moreover, Kruger, Campher & Smit (2009) aimed to determine the role and beneficial impact of a visual skills training program on performance of highly skilled cricket players. Results indicated that the visual skills training program significantly influenced ball handling skills, coordination, visual awareness, eye tracking, accuracy, and peripheral awareness. Overall, Kruger, Campher & Smit (2009) revealed that visual skills training increases a player's visual field and aids them in competitive sports environments. Expanding the visual field is important in sports as it helps athletes guide their eyes to focus and locate moving objects. With a larger visual field, chances of catching or hitting are much greater. In the competitive game of cricket, we see many similarities to baseball and softball such as both are bat-and-ball games, which is why the findings presented by Kruger, Campher & Smith provide support for the current study. If

the visual field can be expanded in cricket, the same is likely to occur on a softball or baseball field as they share similar characteristics. Therefore, this supports the prediction that stroboscopic training, brief moments of obscured vision, will help improve softball players' ability to catch a ground ball.

Paul, Biswas, and Sandhu (2011) analyzed forty-five university level table tennis players who were divided randomly into three equal groups. The goal of this study was to evaluate the effects of sports vision and eye-hand coordination training on sensory and motor performance for table tennis players. Paul, Biswas, and Sandhu reported a statistical significance for the experimental group compared to the placebo and control group. The experimental group also showed improvement in visual variables and motor performance. Overall, it was concluded that visual training improves basic visual skills which can be transferred to performance in a specific sport. The same employment of sport specific training should be applicable to fielding a ground ball in softball. As expected in the current study, the experimental group should show more improvement than the control group. The findings from Paul, Biswas, and Sandhu (2011), align with others and provide a strong argument for further research.

Szymanski and colleagues (2011) investigated the effect of preseason visual training on bat velocity, batted-ball velocity, and pitch recognition with twenty female NCAA Division I softball players. Results from this study showed a significant difference in visual recognition response time, visual tracking response time, and depth perception. There was no significant difference for batting velocity, batted-ball velocity, or pitch recognition. Szymanski and colleagues reported that visual training can improve an athlete's vision skills. However, during the study players were also participating in



their softball-specific skills six days a week for six weeks. Because of the existing confounding variable, Szymanski and colleagues were led to believe further research is necessary. The results from this study, however, demonstrate a positive relationship between vision training and softball, which provides a reason to further explore the topic.

Clark, Ellis, Bench, Khoury and Graman (2012) observed the effects of traditional vision training with the University of Cincinnati baseball team, hoping to determine if it could improve performance parameters such as batting and hitting. Traditional vision training was conducted through the methods of Dynavision, Tachiscope, Brock Sting, Eyeport, Rotary, Strobe Glasses, Near Far Training, and Saccades. To measure vision training with Saccades training, Clark and colleagues placed charts of random letters on a wall, both horizontally and vertically and had players stand at varying distances and had to focus from one chart to another, calling out the letters, alternating from one chart to another for 1-minute. The purpose behind this method of training was to stimulate a fielder chasing a ground ball. Another visual training mechanism used by Clark and colleagues was Tachistoscope, which is a device that trains the brain to recognize images faster. With this methodology, Clark and colleagues flashed numbers on a screen, typically starting with 1 number and gradually adding more numbers to train the athletes to recognize objects in their visual field faster. This study found that traditional visual training methods increased the team's overall batting average from 0.251 to 0.285. According to the Major League of Baseball, batting average is defined as a statistic that measures a player's batting ability relative to the number of at bats (What is a Batting Average, n.d.). Batting averages generally range between 0.250 and 0.275, with respectable hitting averaging 0.300 (What is a Batting Average, n.d.). The vision training

experienced by the University of Cincinnati baseball team showed a 0.034 improvement in the team's batting average, moving the team from 12<sup>th</sup> place in the Big East to a 4<sup>th</sup> place tie. Overall, the results of this study show a positive effect for traditional vision training with hitting performance. One limitation to Clark, Ellis, Bench, Khoury, and Graman (2012) study was that no control group was included. This limitation presents an opportunity for more research.

Additionally, Smith and Mitroff (2012) explored whether stroboscopic training could impact anticipatory timing. Anticipatory timing is an important skill to acquire in sports which allows athletes to predict where a moving stimulus will be at a specific point in time. Comparing an experimental and control group, Smith and Mitroff uncovered that a single 5 to 7-minute stroboscopic training session could produce significant benefits for performance of an anticipatory timing task. The group wearing stroboscopic glasses was significantly more accurate, more consistent, and responded earlier at the timing task. Based on these results, it can be concluded that athletes who use stroboscopic glasses for their training are better at predicting where the ball will be at a certain time. With stroboscopic training, visual sensory is obscured for brief moments of time causing athletes to process more information at once, which is why the stroboscopic group in Smith and Mitroff (2012) displayed a significant improvement in performance. The results presented by Smith and Mitroff (2012) support the current study in the prediction of softball players' ability to field a ground ball with stroboscopic training.

Likewise, Holliday (2013) evaluated whether there was an immediate effect of stroboscopic training at different time intervals, and if stroboscopic training had an effect on catching performance. Holliday's research focused on Dynamic Visual Acuity (DVA),

which is an important variable in sports performance as most sports are dynamic, (Morris, 1977). Dynamic visual acuity helps athletes clearly see objects while they and/or the object is moving fast. Results from this study established a significant improvement in performance for the experimental group for left DVA, total vertical DVA, downward DVA and upward DVA, while the control group's performance decreased for total DVA, downward DVA and upward DVA. Despite the performance differences for DVA, both groups showed an improvement for ball catching performance. Conclusions drawn from this research show that stroboscopic training improves dynamic visual acuity. Results from this study can be directly related to the proposed study as the same catching performance will be analyzed.

Schwab and Memmert (2012) developed a study that investigated whether a sports vision training program could improve the visual performance of youth male field hockey players, ages 12 to 16. Schwab and Memmert concluded that certain visual abilities such as peripheral perception or choice reaction time are trainable and can be improved through visual training. In conjunction with other research, there is a positive relationship between sports performance and vision training. This is clear among many sports but has yet to be tested on young female softball players.

Skating onto the ice, Mitroff, Friesen, Bennett, Yoo, & Reichow (2013) wanted to expand upon previous research showing a positive effect for visual training. The goal of their study was to implement a research training protocol with elite athletes through direct assessments of sport-related performance. They conducted their study on professional ice hockey players from the NHL Carolina Hurricanes who were split into an experimental group and control group. Overall, the results of this study agreed with

previous research showing a positive correlation between stroboscopic training and performance. Mitroff et al. reported that players in the experimental group showed an averaged 18% improvement in on-ice skill performance. Professional NHL players who wore the strobe glasses performed better at relevant skills in their position. As an example, goal scorers becoming better at scoring goals and defensemen becoming better at making long passes. It can be noted that even highly skilled athletes can make performance enhancements through vision training. This eliminates the question of if there is a certain time frame in which athletes need to utilize visual training. From this study it is apparent that anyone can benefit from training, which is valuable to the current study as it examines novice and expert athletes.

Alves, Spaniol & Erichsen (2014) investigated the visual skills of elite Brazilian football players and compared those visual skills scores of players from different age groups and who played different positions. Age groups included in this study were 14-15, 16-17, 18-20, and 20+. In their study, visual skills testing was conducted using a Visual Edge Performance Trainer which is a 3-D computer-based visual skills training program. A significant difference between the age groups was found for visual tracking. Conclusively, Alves and colleagues reported that visual tracking of more developed and experienced elite football players is greater than the visual tracking of younger and less experienced elite football players. Relating to the current study, this information can be applied to the two participant groups as they differ in age as well. The information provided by Alves, Spaniol, & Erichsen (2014) proposed the idea that there is a certain “window” of opportunity for visual training. It can be concluded that older players

benefit more from visual training with the Vizual Edge Performance Trainer than do younger players.

In more recent research, Fransen et al. (2017) examined the influence of restricted visual feedback through the use of stroboscopic eyewear on the dribbling performance of youth soccer players. Measurements were taken for three different dribbling ability levels: fast, average, and slow. Results from this study showed that limiting visual feedback increased dribble test times for all three ability levels. Interestingly enough, Fransen et al. also found that fast dribbles were most effected by reduced visual information. It was suggested that this finding was due to the fact that at higher speeds, soccer players rely on more visual feedback to keep the ball in continuous control. The findings described by Fransen et al. demonstrate an important piece of evidence for this case study. This study examines the stroboscopic effects for two different populations which is similar to the different skill levels examined by Fransen et al. Due to these findings, it can be predicted that both skill levels will increase their ability to field a ground ball.

As demonstrated in previous research across a wide range of sports, visual training is extremely beneficial for athletes' performance. Although there is much support for stroboscopic training, there are many limitations that also exist within the literature. One of the limitations addressed in Clark et al. (2012) is the lack of a control group. The absence of a control group makes the validation of a study more difficult to achieve. Therefore, establishing a control group is crucial for assessing the impact of a treatment and adding statistical power to one's findings. Other limitations found in Holliday (2013) include the focus of a single population. Concentrating a study around one population

makes it difficult to generalize the findings of stroboscopic training across other sports that require different skill sets. Another limiting factor explained by Holliday (2013), expresses that participants may not have enough time to participate in vision training studies because of their lengthy nature. This limitation directly relates to smaller sample sizes. With smaller sample sizes, statistical findings may not prove to be as significant as they would if a larger sample was utilized. Additional research has found limitations regarding where visual training occurs and the cost of implementing that training. In many studies, eye training programs have only been carried out in laboratories and clinical settings causing heavy expenses for athletes (Rezaee, Ghasemi & Momeni, 2012). It is imperative for vision training to be tested in the natural environment in which the athlete will perform. By testing the athlete on their field of play, there is more statistical significance to the relationship between vision training and performance. A fifth limitation present in stroboscopic training arises in Fransen et al. (2017) where it is discussed that stroboscopic training has limited customizability. The pre-determined levels of strobe frequencies are unchangeable making it difficult to manipulate visual feedback for athletes at different skill levels. Overall, a huge limitation in stroboscopic research is that traditional occlusion studies never completely occlude vision (Fransen, 2017). These limitations serve as guidelines to future research and provide support for the current case study.

As of 2013, many coaches believed that 20/20 vision is “good enough” and that no extra effort towards visual training is necessary (Cross et al., 2013). However, with multiple accounts of research showing a positive improvement in performance, why would coaches not want to include vision training on a regular basis? Babe Ruth’s vision

proved to be better than 20/20, indicating that 20/20 vision only meant you were an average player (Baxter, 2007). Because visual training has been shown to be effective across various competitive sports, it is hypothesized that by practicing in situations of poor visual input, individuals will be forced to make better use of their limited visual information. The current study aims to answer the question: Can stroboscopic visual training improve softball players' fielding abilities, and will novices improve more so than expert players?

## METHODS

### **Participants**

Freshman and varsity softball players from Williams Field High School (12 female,  $M_{\text{age}} = 15.3$  years, age range 13-18) participated in this case study for additional practice before the 2019 season to determine if training with Senaptec Strobe Glasses would improve their catching and fielding skills. Freshman and varsity teams were separated and randomly split in half to create each condition. All participants wore the Senaptec Strobe Glasses, however only half of each team trained with the strobe effect "on". It should be noted that such an approach has limitations (e.g., small number of participants) but can offer important case study data to inform future work. Due to such a small sample size, no players were excluded from the study, however players were advised not to participate if they have a history of seizures or epilepsy. All players were compensated in the form of Polar Pops. All procedures were conducted in accordance with ASU's Institutional Review Board and consent forms were collected from each player before participating in the experiment.

## **Material**

The experiment followed a randomized 2x2x2 mixed design with pre-and-post tests. Participants either participated in stroboscopic training to improve their fielding ability over four weeks or experienced no stroboscopic training over four weeks. The stroboscopic and non-stroboscopic training programs were designed with Senaptec Strobe Glasses, 12-inch ASA Wilson Softballs and a Jugs PS50 Perfect Strike Pitching Machine. All testing was conducted at Williams Field High School, where a high school regulation softball field is provided by Higley School District. Participants were required to bring their own softball glove for each training session.

**Senaptec strobe glasses.** To address the current question at hand, Senaptec Strobe Glasses were employed while fielding groundballs. Senaptec Strobe Glasses are designed to train the connections between an individual's eyes, brain, and body. Using crystal technology, the lenses flicker between clear and opaque, removing visual information and forcing the individual to process more efficiently. The alternation rate between transparent and opaque states varies along 8 levels. For the purpose of this case study only one level was utilized (level 1). All players wore the glasses while fielding groundballs, but only half experienced the strobe effect.

**Jugs PS50 perfect strike pitching machine.** To control for outside factors such as ball speed and variance of ground balls, a pitching machine was utilized. This accurate, versatile, and durable pitching machine throws real baseballs and softballs, as well as pitching machine practice balls. With its versatility, the pitching machine can also be used for defensive fielding work. The Jugs® PS50™ Perfect Strike Pitching Machine



was utilized to propel softballs at each participant. This method ensured that all ground balls fielded by the softball players were consistent and equal in difficulty.

**A9031 ASA synthetic leather polycore softballs-SST.** An ASA Certified softball with a circumference of 12 inches and diameter of 3.8 inches. With a compression controlled polycore and super seam technology, this ball has unmatched durability and also allows pitchers and fielders to have extra control. Using the same equipment throughout the study provides consistency and replicability.

### **Performance measures**

Performance accuracy was measured before the four-week stroboscopic training session and at the end of the four weeks. To avoid bias results, a third party evaluated each player fielding twenty ground balls. Evaluations and accuracy were recorded using a 0-3 rating scale. The player received a 0 for missing the ball completely, a 1 for touching the ball but still missing it, a 2 for fielding the ball with a juggle, and a 3 for a clean catch (without any juggling). Additionally, a performance survey was given to each player before and after training to establish their self-esteem and confidence levels for fielding a ground ball.

### **Procedure**

All testing was carried out over the fall semester, prior to the 2019 softball season. Softball players attended practice three times a week for four weeks. Pre-testing measures were recorded at the first practice. For pre-testing, players were evaluated on their fielding accuracy for twenty ground balls. Fielding accuracy was rated on a scale of 0-3. After four weeks of training, players were given a post-test of twenty ground balls to

compare fielding accuracy. Results from the pre-and-post-test were compared to analyze the effects of stroboscopic training.

Freshman and varsity softball players were split into their teams respectively and then evenly and randomly assigned to either the non-strobe or strobe group. All softball players wore the Senaptec Strobe Glasses; however, the strobe effect was only to be turned “on” for the stroboscopic group. The reason behind both groups wearing the strobe glasses was to prevent a placebo effect. Players who wore the glasses were told the strobe was on, and players who wore the glasses without the strobe were told it was off. A placebo effect occurs when people experience a benefit after the administration of an inactive substance or treatment (Resnick, 2017). Requiring both groups to wear the strobe glasses prevented the stroboscopic group from believing they improved simply from wearing the glasses. Both training groups fielded twenty ground balls every day at practice either with or without the strobe effect on. Training sessions occurred Monday-Friday for four weeks. To complete a training segment, each player stood at their infield position and fielded twenty ground balls, which were propelled at them from the Jugs Pitching Machine set up at home plate. For every training session, results were recorded by a third-party observer. After four-weeks a final post-test was given to determine if the players improved or not.

## RESULTS

Previous studies examining visual training in specific sports such as hitting and catching in baseball, reaction time in hockey, batting performance in cricket and basic visual skills used in table tennis have shown a positive correlation between increased performance and visual training methods such as stroboscopic. These results have led to

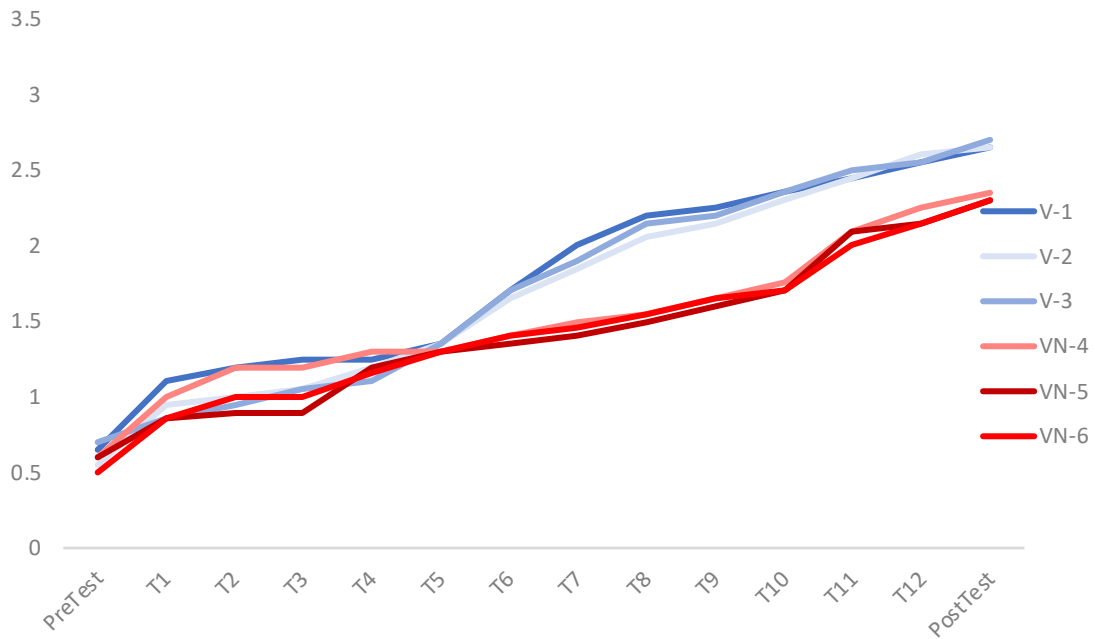
the discussion of this case study, where the goal was to determine if visual training is applicable to the skill of fielding and catching twenty consecutive ground balls and if novices have more potential to improve their skills than experts. It should be noted that the ANOVA findings in this case study are exploratory due to the low sample size. Generally, a low sample size offers little basis for establishing reliability or generalizing the findings to larger populations. The results found in this case study are simply investigatory and are not meant to make strong conclusions, however may bring about an understanding of stroboscopic training within the realm of softball. It was hypothesized in this case study was that stroboscopic training would improve softball players' performance level for fielding a ground ball and novices would have a higher average score for fielding performance as compared to their more expert peers. After analyzing the data with traditional statistical methods, it was found that all players increased in performance level, however, the stroboscopic training group increased from baseline performance levels more so than the non-stroboscopic training group. From the analysis it can also be concluded that skill level was an influencing factor on how much improvement was seen in the players.

Fielding, measured on a 0-3 scale, for the expert varsity players training with the stroboscopic group went from an average score of 0.633 to a 2.666 demonstrating a 20.3% improvement in fielding performance. Varsity players in the non-stroboscopic training group went from an average score of 0.566 to a 2.316, reporting a 17.5% improvement. Novice freshman players in the stroboscopic training group went from an average score of 0.466 to a 2.833, showing a 23.67% improvement in performance. The

novice freshman group in the non-stroboscopic group went from an average score of 0.416 to a 2.500. This is a 20.84% improvement in performance.

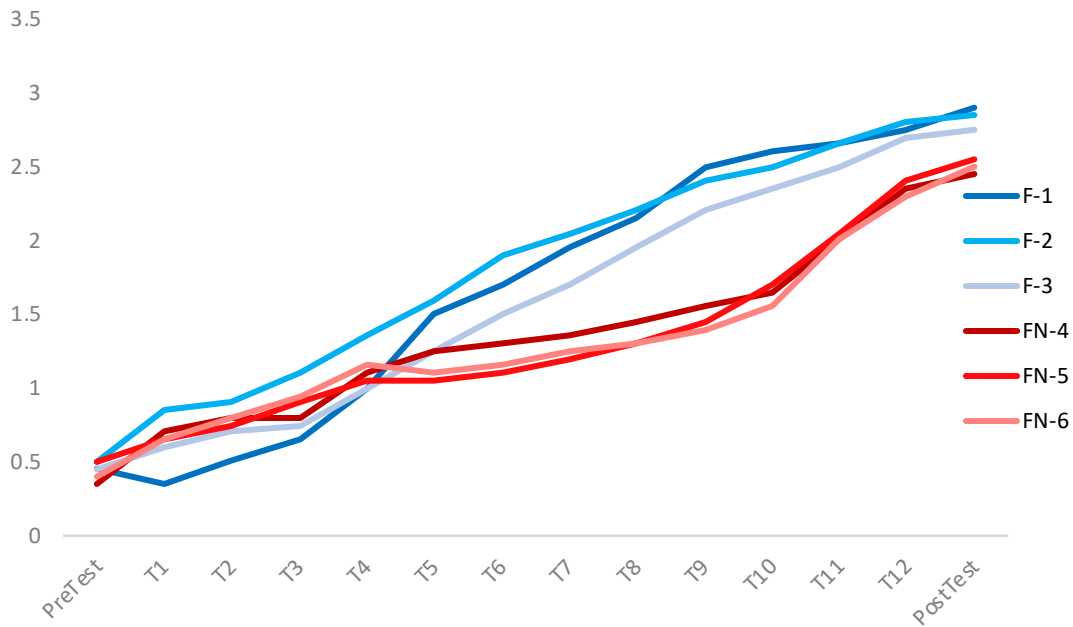
A repeated measures ANOVA test was conducted in this case study to test if skill level and training method had an effect on the dependent variable, fielding performance in softball. The within subjects test indicated there was a significant main effect for phase,  $[F(1,8)=16072.067, p=0.000]$ , or in other words, pre-and-post-test scores would improve. The interaction of phase x skill  $[F(1,8)= 123.267, p=0.000]$  and the interaction of phase x training group  $[F(1,8)=91.267, p=0.000]$  were significant which means that players' starting ability level influenced their final average fielding performance and that the type of training received, stroboscopic or not, manipulated performance levels. The main effect between skill level and phase occurred because novice freshman players have the capacity for more improvement than expert varsity players. The main effect of training group and phase occurred because softball players, expert and novice both, increased their average scores in fielding performance when comparing pre-and-post test scores. The three-way interaction between phase, skill level, and training group was not significant  $[F(1,8)=0.600, p=.461]$ . The between subjects' test indicated that the variable "Training Group" had a significant main effect  $[F(1,8)=49.390, p=0.00]$  while "skill" did not have a significant main effect  $[F(1,8)=0.024, p=0.880]$ . To visually understand the statistically significant values reported, fielding scores of expert varsity players and novice freshman players in each training group are presented below in Figure 1A, 1B, 2A and 2B. Highlighted in all four figures are the improvements made by stroboscopic training and the influence skill level had on the results.

### Varsity Strobe vs. Non-Strobe



*Figure 1.* V-1, V-2 and V-3 depict Varsity players in the stroboscopic training group. VN-4, VN-5 and VN-6 depict Varsity players in the non-stroboscopic training group. Displayed in the graph on the vertical axis is each Varsity player's average performance score for fielding a ground ball during each training phase. On the horizontal axis is the number of training sessions. Results in the graph indicate a larger increase in performance for the Varsity stroboscopic training group compared to the non-stroboscopic training group.

## Freshman Strobe vs. Non-Strobe

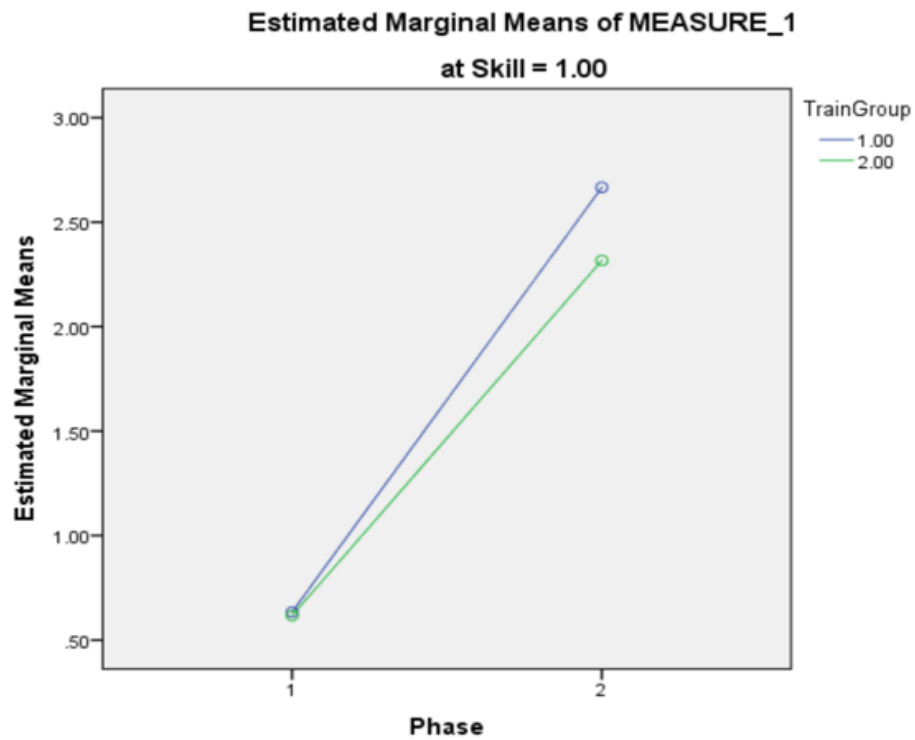


*Figure 2.* F-1, F-2, and F-3 depict Freshman players in the stroboscopic training group.

FN-4, FN-5 and FN-6 depict Freshman plays in the non-stroboscopic training group.

Displayed in the graph, on the vertical axis is each Freshman player's average performance score for fielding a ground ball during each training phase. On the horizontal axis is the number of training sessions. Results in the graph indicate a larger increase in performance for the Freshman stroboscopic training groups.

**Phase \* TrainGroup \* Skill**



*Figure 3.* Displayed is the marginal mean value for Varsity players in their respective training groups. Training group 1 used the stroboscopic glasses in their training sessions and showed a greater increase in performance as compared to training group 2.

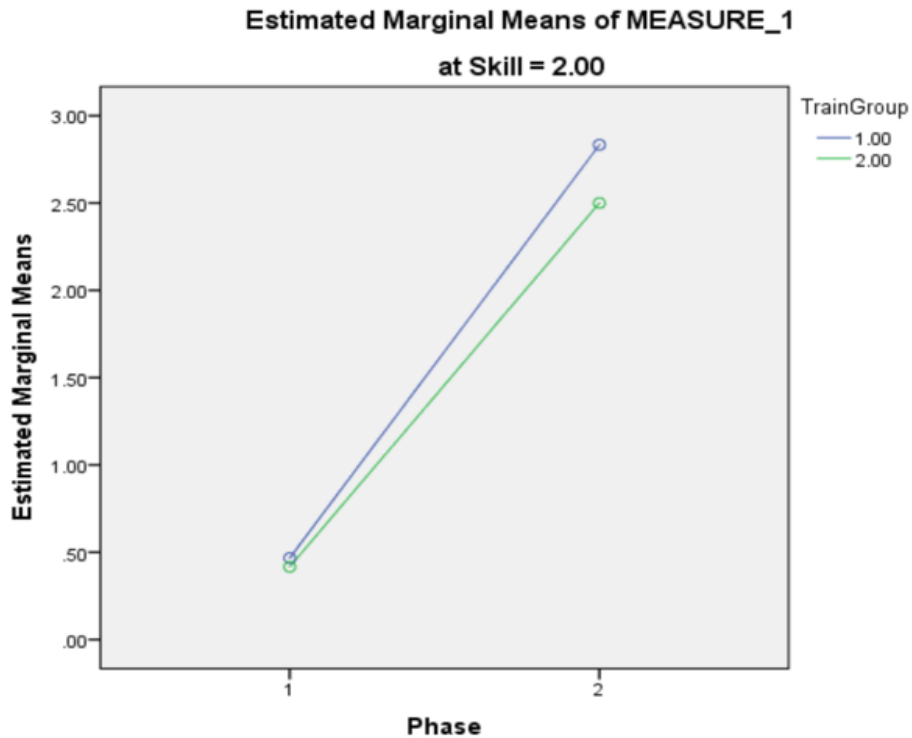


Figure 4. Displayed is the marginal mean values for Freshman players in their respective training groups. Training group 1 used the stroboscopic glasses in their training sessions and showed a greater increase in performance as compared to training group 2.

From figures 3 and 4, it is important to note the difference in marginal mean. In figure 4, the novice freshman players have a higher mean than the varsity players, displayed in figure 3, which supports the hypothesis that novice players have more potential for improvement.

The qualitative data analysis from the semi-structured interviews yielded complimentary patterns. From the qualitative data it was reported that players felt their ability level, self-esteem, and confidence increased while their effort level and nerves decreased. Themes that emerged from qualitative data also included feelings about



reaction, judgement, and focus. One player reported, “After training with the stroboscopic glasses I felt like my reaction to the ball was a lot better, and that it was easier to judge or predict the flight of the ball and the path of the ball, essentially I feel like I can track the ball better.” Another player stated, “Being a novice player, I am quite scared of fielding groundballs, however with the stroboscopic training, I am not as nervous to field a ground ball anymore and I feel like my ability to focus on the ball is better.” Combining the results from the qualitative and quantitative data, it can be concluded that stroboscopic training aids in the improvement of fielding performance for novice and expert softball players. Additionally, it can be concluded that stroboscopic training is very beneficial for younger novice athletes who have more room for growth.

## DISCUSSION

With the fast movements that occur in sports, there is a great demand placed on the human visual processing system. “It is essential for an athlete not only to know how good their eyesight is, but also how good their vision is, that is how well the brain can interpret the information the eyes pick up,” (Maman, Gaurang, & Sahnhu, 2011). The more efficient an athlete becomes at interpreting sensory input from sports, the better the athlete they will become. Hence, the reason for the current case study’s examination on stroboscopic vision training.

This case study brings many new and different components to the research on stroboscopic training. First, the focus of this study was on stroboscopic vision training for high school softball players which has not previously been studied. In addition to researching a new population, other various limitations from previous research were addressed in this study. One major limitation in previous research is the lack of control

groups. To avoid this limitation, participants in this case study were randomly placed into an experimental or control group. By adding a control group, this study brings more statistical significance to the findings that stroboscopic training increases softball fielding performance. Another barrier in previous research is time. To overcome the obstacle of time, training sessions were implemented into practice so participants did not have the barrier of devoting more time to stay after practice. With this methodology, more softball players were able to participate in the study, which gives greater support to the findings. Last, this case study was conducted on an actual softball field. Many studies lack training in game-like settings, which makes it difficult to determine if an athlete will experience the same benefits of improved performance in both settings. Using game-like environments instead of a laboratory or clinical setting adds support to previous research and the results found in this study. These changes from previous research add significance to how stroboscopic training can be beneficial in softball much like it is in baseball, cricket, hockey or soccer.

With the high school softball players, it was predicted that training with stroboscopic glasses would improve one's performance more so than non-stroboscopic training for fielding groundballs. It was also predicted that novice players would show a higher level of increased performance than expert players. Qualitative and quantitative data collected in this case study support both hypotheses. Comparing average fielding performance, varsity players who trained with the stroboscopic glasses increased their ability by 20.3% whereas the non-strobe players only increased by 17.5%. Freshman players trained in the stroboscopic group improved by 23.67%, significantly higher than non-strobe players who increased by 20.84%. Marginal means for freshman novice

players indicated more improvement which was due to that fact that novice players have more room for growth and possess a greater potential to develop skills. Players involved in the case study reported feelings of improvement, which essentially boosts confidence and results in better performance.

The findings presented in this case study are similar to those found in previous studies that have examined the importance of visual training for increased performance. In many different fields of play, previous research has found supporting evidence that visual training can enhance skills such as reaction time, depth perception, and hand-eye coordination. Specifically, in previous research baseball and cricket teams have found marked improvement in batting averages, soccer players are better at dribbling, hockey players can better predict movements of their opponents, and table tennis players have displayed better hand-eye coordination. The purpose of stroboscopic training is to improve visual and perceptual performance by having individuals perform activities under conditions of intermittent vision, (Wilkins, Nelson, & Tweddle, 2018). The form of training permits athletes to process what they see more efficiently. Dr. Bernhard Sabel, a neuroscientist at Otto von Guericke University in Magdeburg, Germany reported that if visual sensory neurons are repeatedly activated, they increase their ability to send electrical signals from one cell to another across connecting synapses, (Murphy, 2014). With visual training, the sensory neurons are constantly being activated, conclusively affecting an athlete's performance.

Supporting the concept of visual training that is designed to help athletes perceive their surrounding sports environment, is the concept of deliberate practice and cognitive workload. Visual training, and in this case specifically stroboscopic training, is a form of

deliberate practice that promotes skill development through an increase in knowledge and strategies. In this case study, players were exposed to immediate feedback and results of their performance which are key factors of deliberate practice. The stroboscopic glasses were chosen as an addition to the training regimen in order to teach and challenge the softball players on the correct fundamentals for fielding a groundball. As the players engaged in the training regimen, they were able to analyze the path of the groundball and spend less time deliberating what action to take. Due to the stroboscopic training, fielding a groundball became more of a routine for the players, which required less cognitive demand.

### **Limitations**

Further data needs to be collected with a larger sample size over a longer period of time to support the significant findings found in this case study. In this case study, the sample size was limited due to the amount of softball players at Williams Field High School. Results from this case study were collected during the fall semester at a time when many of the softball players participated in other sports which prevented time on the field. Additional research needs to include more training phases to ensure increased performance will become engrained. For this case study a pre-and-posttest along with twelve training phases was completed. Completing more training phases will also provide more support for the current findings. Both additions will ensure more meaningful data and results.

## CONCLUSION

“Fielding performance, although statistically difficult to assess, is considered a significant factor in the outcome of a professional baseball game, accounting for approximately one-fifth of total wins during a major-league season,” (Mangine et al., 2013). In summary, the current case study suggests that stroboscopic visual training can improve softball players’ ability to field a ground ball. Results from this case study, as well as others, provide valuable insight for an effective training regimen. The expansion and knowledge of what visual training can do is important. The results obtained in this case study are beneficial to the field of sports and athletic training because it is essential for any level of athlete. From the weekend warrior, to the professional athlete, to the young new athletes, increasing one’s visual skills will aid each individual’s accuracy, efficiency and endurance in sports.

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