Training with StrobeSpex: Their effects on ball-catching performance

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Training with StrobeSpex: Their effects on ball-catching performance

Abstract
The visual enhancement effects of StrobeSpex®, a new product available to sports vision enthusiasts, was assessed. Even though this product is readily used by many teams and athletes who strongly believe in its ability to improve performance, no solid scientific documentation supports this effect. The impact that StrobeSpex® training may have on an individual’s ability to catch tennis balls propelled from a tennis ball machine was examined. A series of pre-testing, training, and post-testing sessions were conducted to investigate StrobeSpex® efficacy. To do so, forty-four Pacific University College of Optometry students had their ball catching ability assessed using qualitative and quantitative scales during the testing sessions. Contrary to our hypothesis upon completion of a two week training phase, it was concluded that no significant improvement in ball catching by the experimental group (StrobeSpex® training) was found after comparing their pre-training and two post-training scores. The only statistical significance revealed from the post-tests was in relation to time, meaning that the groups performances improved with every testing session. This type of finding soundly indicates a learning effect occurred with testing. Future studies on the effectiveness of StrobeSpex® training need to be performed to statistically demonstrate their worth in performance enhancement.

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TRAINING WITH STROBESPEX®: THEIR
EFFECTS ON BALL-CATCHING PERFORMANCE

By

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ABSTRACT:

The visual enhancement effects of StrobeSpex®, a new product available to sports vision enthusiasts, was assessed. Even though this product is readily used by many teams and athletes who strongly believe in its ability to improve performance, no solid scientific documentation supports this effect. The impact that StrobeSpex® training may have on an individual’s ability to catch tennis balls propelled from a tennis ball machine was examined. A series of pre-testing, training, and post-testing sessions were conducted to investigate StrobeSpex® efficacy. To do so, forty-four Pacific University College of Optometry students had their ball catching ability assessed using qualitative and quantitative scales during the testing sessions. Contrary to our hypothesis upon completion of a two week training phase, it was concluded that no significant improvement in ball catching by the experimental group (StrobeSpex® training) was found after comparing their pre-training and two post-training scores. The only statistical significance revealed from the post-tests was in relation to time, meaning that the groups performances improved with every testing session. This type of finding soundly indicates a learning effect occurred with testing. Future studies on the effectiveness of StrobeSpex® training need to be performed to statistically demonstrate their worth in performance enhancement.

KEYWORDS: StrobeSpex®, ball catching, vision enhancement
INTRODUCTION:

Over the years, training with strobe lighting has been integrated into various sports to enhance visual performance, believing it would have a positive effect on the athlete’s overall performance. For implementation, this type of training required a completely darkened area and numerous synchronized strobe lights. As a result, a limited training environment in an unnatural setting is created. Realizing these limitations, Dr. Randall Fuerst developed the StrobeSpex®, a multi-purpose, extremely versatile pair of special glasses that simulate the same effect as strobe lighting. This device allows athletes to easily incorporate this type of training into their routine environment without the confines.

StrobeSpex® are glasses incorporating a liquid crystal shutter system built into the lenses that open and close in front of the eyes; thus presenting visual information to the athlete in a fragmented form, very similar to strobe lights. The fact that StrobeSpex® have little restriction in terms of their use may possibly make them highly beneficial to almost any athlete. Not only can they be used indoors, but also outdoors on the football and baseball fields, as well as tennis courts. They are also lightweight, comfortable and minimal enough to fit under football helmets and various sports masks.

With the competitiveness of sports continually growing among all levels, the athletes coaches, trainers are constantly looking for any edge to improve the athlete’s performance. This is especially true in professional sports, where even the slightest performance improvement on a consistent basis can result in a much compensation. Since it’s introduction to sports, StrobeSpex® have made their way into training programs with numerous professional teams such as the San Francisco 49’ers and the New England Patriots. But it is important to note that StrobeSpex® are likely to be a benefit to athletes at all competitive levels.

Separated subjective effects of normal stroboscopic training include increased ease of catching the ball and the object of regard appeared to move at a slower speed and/or appeared much larger than prior to training. Since these phenomena have been mentioned to exist using strobe lighting, we wanted to know if they could be repeated after an athlete had utilized StrobeSpex® as part of their training. We were unable to find any published laboratory or clinical evidence regarding these phenomena due to the use of strobe lights or StrobeSpex®, but a previous thesis by Gehler and Solbrack (1989) did discuss their subjects report of these phenomena. An unpublished study by Dr. Fuerst on the Sacramento City College baseball team did report improved player’s dynamic visual
acuity, visual reaction time, and depth perception following StrobeSpex® training. Also noted was improvement in batting performance by the experimental group of players.

Consequently, we wanted to investigate whether the StrobeSpex® would enhance an individual’s ability to more accurately anticipate the location in space and time of arrival of an object. In order to successfully perform a task of ball catching, the authors felt the subject’s would require good visual reaction time, good eye-hand coordination, and accurate visual processing. If subjects were found to be deficient in one or more of these skills during our pre-training tests, we expected the StrobeSpex® would enhance the necessary skill(s) through training, with resultant post-training enhancement.

Wearing StrobeSpex® results in the elimination of visual information due to the non-visible phase. Therefore, the authors feel individuals must process visual information more efficiently with the StrobeSpex® in order to successfully catch a ball.

Relevant studies performed in the past, include one by Hubbard and Seng (1954). They examined the relationship between eye movements and ball-catching and hitting. Overall, they discovered that in visually tracking a baseball, the hitters used pursuit eye movements and held their head essentially fixed. They also found that pursuit eye movements deteriorate at high velocities, resulting in the cessation of the eyes tracking a ball 8 to 15 feet from the batter. Because StrobeSpex® flicker on and off it may be assumed that pursuit movements are disrupted resulting in more saccadic type eye movements. Bahill et al (1981) claimed that baseball and tennis players do not “keep their eye on the ball” and that it is physiologically impossible to do so. They found that while the athletes head is fixated, they follow the ball over the start of its trajectory, calculate its future position, make a quick saccadic eye movement to the anticipated location, and then continue tracking. Thus, one might suspect StrobeSpex® to have some impact on this aspect of ball catching.

In summary, the purpose of our study is to determine whether StrobeSpex® training enables an individual to improve their ball catching skills through more accurate prediction of future location of a projected tennis ball.

**METHODS:**

Forty-six subjects were recruited from the Pacific University College of Optometry student body. The subjects consisted of 12 females and 34 males. All forty-six subjects completed our screening and pre-training sessions. Two, one male and one female, were
unable to return for the remaining sessions either, training, immediate post-test or 24 hour post-test; therefore, leaving our study with forty-four subjects. Subjects were informed the experiment would involve three testing sessions where they would be asked to catch tennis balls projected from a tennis ball machine, in addition to playing catch with a tennis ball during the training portion. The testing portion would take place in a squash court where balls would be shot at five different areas around their body. Subjects where informed that no ball gloves would be allowed, and that catches would be made bare-handed. They were informed that protective eyewear would be supplied for all the training and testing sessions. As incentive, each subject would earn twenty-five cents per successful catch in testing sessions, with 75 total catches possible (25 per testing session). In addition, they would earn a monetary bonus for participation through the whole experiment, plus a free meal. It was also explained to the participants that the money and the meal would be given to them only if they completed in every aspect of the study.

The study took place over a three week period consisting of a pretest session, followed by a ten day training period, and ending in back to back days of post-testing. The screening and testing portions took place at the Pacific University Athletic Center inside a regulation squash court. Training took place in Pacific University College of Optometry’s Jefferson Hall inside one of the buildings class rooms. Both buildings are located on the campus in Forest Grove, Oregon. Illumination in both settings was provided by overhead fluorescent lighting providing approximately 60 foot candles.

Data was collected on each subject at the three separate testing sessions. The initial two day session involved the screening tests followed by the pre-training ball-catching session. This was succeeded by the ten day training portion. After the subjects completed their final training session they immediately had their first post-test session, which was followed by a second post-test session the following day. In our study, the experimental group used the StrobeSpex® glasses (Figure 1) for the training portion, while the control group used StrobeSpex® frame with lenses mounted in them that matched the same light transmittance as the StrobeSpex® during their open phase. The pre-training and two post-training portions were identical in all respects.

Prior to being accepted to the study, the students had to pass screening criteria by demonstrating a minimum of 200 arc seconds of stereopsis at 40 cm measured by the Titmus Stereo 4 Ball Test, and possess 6m static visual acuity of 20/20, or better, OU. Their visual acuity was measured using a standard Snellen projected chart and had to be obtained through corrective contact lenses or without any correction at all.
Once the subjects passed the screening section, they were given protective eyewear (New Yorker by Leader). Each participant was given the same set of instructions prior to the start of testing:

“Stand with your feet straddling the line marked on the floor with your hands at your side. Once the machine is started, you will be given six tosses at each of the five locations around your body (Figure 2). The first toss at each location will be considered a practice; therefore, it will not be scored. Upon each catch attempt you must return your hands to your side. Try to catch as many balls as possible. Good luck.”

As seen in the figure 2, the balls were directed in sequence to the subject’s right, knee-high; subject’s right, shoulder high; directly above their head; subject’s left, shoulder high; and subject’s left, knee high. The tennis balls traveled at speeds of approximately 25-30 mph, as determined by a radar detector.

All attempted catches or qualitative analysis were scored by an impartial body not involved in the experiment. Scoring for each catch or attempted catch was based on the following six-point scale:

<table>
<thead>
<tr>
<th>POINTS</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Clean catch (no fumbling or difficulty)</td>
</tr>
<tr>
<td>4</td>
<td>Slight trouble in making catch</td>
</tr>
<tr>
<td>3</td>
<td>Extreme bobble but made catch</td>
</tr>
<tr>
<td>2</td>
<td>Touched ball and almost made catch</td>
</tr>
<tr>
<td>1</td>
<td>Touched ball but with no chance to catch it</td>
</tr>
<tr>
<td>0</td>
<td>Did not touch ball in attempt to catch it</td>
</tr>
</tbody>
</table>

Once all the subjects completed the pre-training portion, their qualitative ball-catching scores were numerically organized from highest to lowest, and the subjects were evenly separated into experimental and control groups, twenty-two in each.

The subjects reported for the start of the ten day training phase the next week. The ten day training section spanned a total of fourteen days. Subjects were asked to play catch, using an underhand toss, with a partner from their own group. They were required to play catch for a total of ten minutes every day, using a different partner on consecutive days. Both groups performed the training under normal room illumination at a distance of fifteen feet.
The study was designed so that the only difference between the control and experimental group was that the experimental group played catch with the functioning StrobeSpex® over their eyes. As mentioned, the control group trained using lenses that simulated the open phase of the StrobeSpex®.

The initial settings on the StrobeSpex® for the control group was set so the liquid crystal shutters would flash open and closed in both eyes at the same time, and length of the time the shutter was open or closed were equal. The shutter speed for the first two days of training was arbitrarily set at 450 cpm. The speed of the shutter was then reduced 75 cpm every other day of training, leaving the shutter speed on the last two days of training at 150 cpm. No modifications to the eyewear were made for the control group during training.

In order to be able to test our subjects immediately after their last training session, we were required to shift to a different location for this final training session. Testing immediately after their last training session was designed to see if there is any benefits of training with the StrobeSpex® immediately prior to athletic performance. To meet this need, the final training session took place in an area outside the testing squash court under similar lighting conditions, with everything else remaining the same as other training sessions. This shift in location we believed would have no variance on our outcome. All subjects, experimental and control, participated at this location.

The equipment set-up for the pre-test and two post-test sessions were identical. The tennis ball machine was set-up at the front wall of the squash court (Figure 3). Thirty-six new Spalding tennis balls for the pre-test session were projected in the direction of the subjects at a rate of one discharge every 4 seconds. These tennis balls were then used for all the training periods. Thirty-six new tennis balls were then put into use for the two post-test sessions. A wood bracket with notches at specific points was utilized as a means of aiming the nozzle of the tennis ball machine at our five different locations. The subjects stood 24 feet away from the tip of the tennis ball nozzle. Again each subject wore the protective eyewear.

The tennis ball machine entails a long nozzle for aiming the tennis balls. It was positioned so there was no movement horizontally accept when the machine was shifted from side to side in order to line up the nozzle with the appropriate notch. By moving the machine from side to side, it allowed the subject to stay in one place, and not have to worry about their positioning in between catches. One unbiased individual was used to run and direct the tennis ball machine, while another directed and provided all the instructions to the subjects. A third individual recorded all the subject's catches and misses. All experimenters were
positioned along the front wall of the squash court, with the subject placed near the back wall so that they would not be distracted by any observers on the balcony above the court. Each testing session lasted approximately 7-10 minutes per patient.

RESULTS:

A repeated measures analysis of variance (ANOVA) was performed to determine the statistical outcome of the study. Three different analyses of the ANOVA type were performed. The first considered an overall analysis, the second, a positional analysis and a third, the sum of positions analysis. As the author’s moved from the first to third analysis, the subjects within each had to meet a specified criterion, as will be stated.

Forty-four subjects, twenty two in the experimental and twenty two in the control were considered in the overall analysis. The first comparison done was between the two groups. As seen in table 1, no significant improvement in ball catching was shown between groups, $F(1,42)=0.36$. When examining strictly position, statistical significance was shown at position “A”, $F(4,168)=4.04$, $p=0.004$. When considering time, there also was a statistically significant difference between the two groups, $F(2,840)=31.78$, $p=0$. However, the author’s related this to there being a learning effect, meaning that whether StrobeSpex® were worn or not worn, the subjects over time showed improvement.

Looking at the interactions between the group and position, $F(4,168)=1.61$, group and time, $F(2,84)=0.38$, position and time, $F(8,336)=1.54$, and group, position and time, $F(8,336)=0.93$, no statistical significance was shown. Even though position and time when considered individually showed some sort of statistical significance, when looking at the interaction between the two, they canceled one another out and showed no significance.

A second analysis between the control and experimental group was performed to see if there was any improvement at any of the five locations at which the balls were tossed. In this analysis, the authors limited the number of subjects within each group to those who had a maximum of 17 points at each position during pre-testing. Again, when looking at the group comparison, no statistical significance was shown at any of the five locations. When looking at time as an effect there was statistical significance, but once again the authors felt this was related to a learning effect because both the control and experimental groups improved. When comparing the interaction between group and time at the five different locations, there was a statistical significance at position “A”, $F(2,62)=4.04$, $p=0.022$. But, at positions “B” through “E” none was shown. This can possibly be related to the subjects level of interest and concentration prior to beginning ball catching.

The third analysis consisted of those experimental and control subjects whose total points at all five positions equaled 90 points or less and 70 points or less (maximum points being 125). When looking at those subjects who scored 90 points or less, no statistical
significance was shown between groups, $F(1,27)=1.17$, nor the interaction between group and time $F(2,54)=1.00$. But, once again time considered as an individual effect showed significance, $F(2,54)=28.63$, $p=0$. When looking at those subjects with 70 points or less the same statistical analysis as stated above proved true. No significance was shown between group, $F(1,17)=0.70$, or the interaction between group and time $F(2,34)=0.56$, but time alone showed significance, $F(2,34)=23.78$, $p=0$, but once again related to a learning effect.

**DISCUSSION:**

Prior to this study, StrobeSpex® had not been tested for significance as a training tool to enhance ball catching performance. Our hypothesis stated that by training with StrobeSpex®, ball catching ability will be increased. Optometry students were asked to volunteer in the StrobeSpex® study provided they had a visual acuity of 20/20 and show stereopsis of 200 arc seconds or better. The total number of volunteers equaled 44 students. The quantitative research was then conducted using three areas of evaluation.

First, a pre-test involved the 44 subjects catching 25 tennis balls thrown by a tennis ball machine maintained at a speed of approximately 25-30 mph. The pre-test was conducted with the tennis ball machine in five different positions of aim. This test revealed each subject’s baseline ability related to the number of balls caught.

Second, the 44 subjects were then randomly assigned to either a control group or experimental group by a computer. The 22 volunteers in the control group wore the same transparent spectacles and participated in 10 minutes per day of underhand tennis ball tossing with a partner for ten days. The experimental group simultaneously consisted of 22 volunteers in the same ten minute underhand ball tossing exercise for ten days wearing StrobeSpex®. Every other day the shutter speed was slowed. After the ten days of training, which spanned a period of 2 weeks, the ball catching test was performed on both groups immediately after removal of the spectacles. The subjects then returned in 24 hours to repeat the test to investigate if a delayed beneficial response existed. Statistics on each volunteer were collected during testing, related to the number of successful catches. At the end of the testing, these statistics were analyzed through a computer program to measure the impact the StrobeSpex® training had on the ball catching exercise. This analysis revealed no conclusive data to prove the experimental group had any significant improvement in performance.
Finally, a post-test questionnaire was administered to each volunteer to collect subjective data on the use of StrobeSpex®. This information revealed that those who used StrobeSpex® felt they were a useful tool in ball catching training. They reported that StrobeSpex® made the ball appear to move at a slower speed, along with it the ball appearing larger in size. In addition, subjects felt it improved their concentration on the ball and made them focus on following the ball all the way into their hands. Thus, even though they may have not statistically shown any improvement, they felt more confidence in their ability to catch the ball following the training with the StrobeSpex®.

Gaps in the data collected may be attributed to the length of the test period. It is the author's opinion that an expanded test period may identify more valuable long term results as well as patterns that reoccur in data. Gaps also were found in the number of catches possible in the ten minute time frame. Not only did this vary from subject to subject, but also did not account for mistakes made during testing.

Several limitations of the study were identified with the analysis of data. The subjects available to participate in the study posed a limitation in that the study was not restricted in the areas of age, sex, or prior athletic experience. Had specifications in these areas been set up for the subjects, a homogeneity could have been established. Volunteers with similar background may provide more usable data to clarify in what population StrobeSpex® would be most useful. The physical dimensions of the testing field also provided a limitation. Application of the use of StrobeSpex® may be more apparent if the controlled environment could resemble a more realistic athletic situation. For example, the distance from a pitcher's mound to home plate could be replicated. A limitation was also identified with the shutter speed of the StrobeSpex®. Optimal strobe speed was not identified for training of this kind. Recommendations for further study would involve recognizing these limitations and expanding research to include homogeneity of the sample, and adjustments of test environment and shutter speed.

Statistical significance in research does not always prove the study to be clinically significant, but these statistical findings are not the sole means of establishing the study's merit. On the basis of the collected data, no generalizations can be made beyond this sample to probe StrobeSpex® to be useful in sports vision training. However, the subjective data collected in this report identifies a need for future study. The other aspects of the research, such as theory, sample, instrumentation, and methods, may be adjusted to reveal more relevant data. Optimal testing and training conditions for StrobeSpex® to be beneficial have not yet been identified.
CONCLUSION:

The investigation of StrobeSpex® and their enhancement on ball catching was initiated by this study. The original hypothesis was not supported by objective data; however, the data collected from the post-test questionnaire has provided subjective information to prove the hypothesis relevant. Using this study as the basis for further testing, research may be developed to provide more scientifically valuable information. Overall, this study provided some evidence that StrobeSpex® may be useful for ball catching application and the need for further investigation.