Acute and Retentive Visuomotor trends from Sport-Specific Stroboscopic Vision Training in NCAA Lacrosse Players

D. Payfer-Lockling, C. Reyes | Linfield University – McMinnville, Oregon
Department of Health, Human Performance, & Athletics– Wright Family Sports Science Lab

ABSTRACT

Stroboscopic vision training (SVT) is the practice of placing individuals under conditions of intermittent vision, often using specialized eyewear, in an attempt to enhance visual and perceptual skills. PURPOSE: To determine if SVT induces both acute and retentive visuomotor benefits in comparison to athletes' baseline scores of cognitive abilities related to sport. METHODS: NCAA Division III female lacrosse players (n = 16) were recruited to participate in the study. All participants completed a pre-test battery assessing visuomotor skills including reaction time, depth perception, perceptual awareness, and eye-hand coordination using a sensorimotor station (*Senaptec*, Beaverton, OR). Participants were randomly assigned into two groups: a control group (n=10) and SVT group (n=6); from there, athletes completed a 2-week sport-specific vision training program, 4 sessions per week. Upon completion of the 2-week training period, all participants completed a post-test assessing the same visuomotor skills as pre-test. In addition, one week after post-testing, athletes then completed the visuomotor tests again to assess if there were retentive qualities from training. RESULTS: The SVT group displayed statistically significant improvements from pre-test to retention test in perceptual awareness accuracy; and statistically significant regressions from pre to posttest eye-hand accuracy ($p < 0.05$). Despite the small sample size, SVT group displayed observable trends towards improvement in reaction time from pre to post ($p = 0.067$), as well as positive trends towards perceptual accuracy pre to post ($p = 0.088$). CONCLUSION: The results and trends from this study support previous vision training research in that SVT acutely produces visuomotor benefits. Retentive benefits of SVT were backed by one statistically significant change in perceptual accuracy from pre to retention test. Future research should include a larger sample size and extend training to 4-weeks to determine if longer training cycles have a greater influence on athletes' ability to retain visual cognitive abilities.

INTRODUCTION

SVT is the practice of placing individuals under conditions of intermittent vision, often using specialized eyewear, in an attempt to enhance visual and perceptual skills [5]. Current research on stroboscopic vision training is still in its early stages. Much of the concurrent research have been associated with balance or generalized movement tests [2]. However, sports performance professionals and researchers have displayed a growing interest in Stroboscopic vision training as a means to improve visuomotor skills such as reaction time, depth perception, perceptual awareness, and eye-hand coordination amongst many other measurable skills. Acutely SVT intervention had been found to produce beneficial adaptations in athletes' central visual field sensitivity, information processing efficiency, and overall attention [1]. Several studies that have incorporated team sports have suggested that future research is necessary to determine if there are any long-term or lingering benefits of vision training [5]. If SVT were to elicit a retentive super-compensation response, similar to an elicited strength training adaptation, sports performance professionals may seek to apply SVT intervention for visuomotor and cognitive skill development in their athletes.

PURPOSE & HYPOTHESIS

The purpose of this study is to assess if sport-specific stroboscopic vision training meaningfully changes visuomotor and cognitive skills related to sport. Additionally, this study aims to determine whether or not acute changes in visuomotor skills display a retentive and/or lingering effect post-training.

METHODS

Subjects

- 16 NCAA Division III varsity Women Lacrosse players (20.36 ± 1.01 years old; 126.30 ± 6.89 cm).
- The team was randomly split into a control group (n=10) and an SVT intervention group (n=6).
- Read and signed an informed consent form approved by the institution IRB and physical screening questionnaire (PAR-Q+) prior to participation.

Testing Procedures

- Dependent variables measured on a sensorimotor station, both pre- and post-testing
  - Senaptec, Portland, Oregon, Figures 1 and 3).
  - Reaction Time
  - Depth perception
  - Perceptual awareness
  - Eye-hand coordination

Training

- Control & SVT groups both underwent 4 training sessions per week over a 2-week training block, however, the SVT group did so with Senaptec Strobe Classic Glasses (Figure 2) at a frequency of 5hz.
- The training incorporated a blend of sport-specific and visuomotor drills daily to enforce both the technical and cognitive capabilities of athletes (Figure 4).

Retention-Test Procedure

- Following a 10-day hiatus from training, all athletes returned to the lab to complete the same 4 reaction time, depth perception, perceptual awareness, and eye-hand coordination assessments. This data allowed the researchers to determine if there was a retentive quality to athletes' visuomotor capabilities compared to baseline scores.

TEST	DESCRIPTION
Reaction Time	Assessment of one's ability to anticipate a stimulus, and the subsequent action taken in response.
Depth Perception	Assessment of one's ability to make judgments of an object and its distance relative to their body.
Perceptual Training	Assessment of one's ability to collect central and peripheral vision data, as well as spatial memory.
Eye-Hand Coordination	Assessment of one's ability to make quick and accurate reactions to an external stimulus.

Table 1: Description of cognitive assessments on sensory station

Figure 1: Senaptec Sensorimotor System

Figure 4: Athlete wearing SVT glasses completing Peripheral Awareness Chart

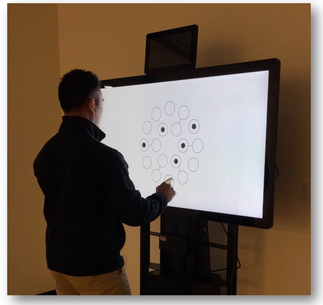

Figure 3: Perception Span test

Figure 2: Stroboscopic vision glasses

RESULTS

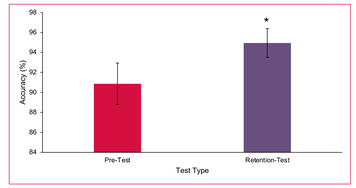

***Figure 5**: Perception training assessment. Statistically Significant improvement for SVT Group in Perception Training Accuracy from Pre –to Post-testing (p=0.013). * denotes statistically significant difference.*

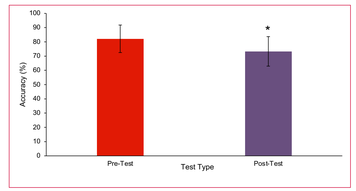

***Figure 6**: Eye-hand coordination assessment. Statistically Significant regression for SVT Group in Eye-Hand Coordination Accuracy Pre-test to Post-test (p=0.0004.) * denotes a statistically significant difference*

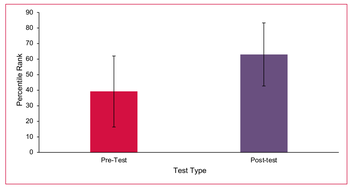

***Figure 7**: SVT Group's qualitative trend in Reaction Time Percentile Ranking amongst all NCAA DIII Women's Lacrosse Players.*

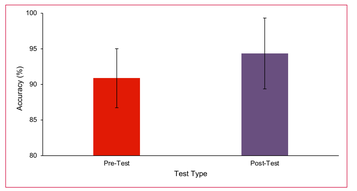

***Figure 8**: SVT group's qualitative trend in perception training accuracy between pre-testing and post-testing.*

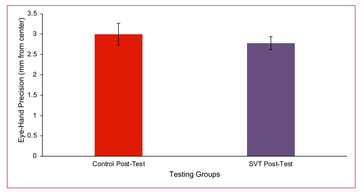

***Figure 9**: Qualitative data depicting the SVT group trending towards more precise eye-hand coordination placements compared to control.*

CONCLUSIONS & PRACTICAL APPLICATIONS

These results conclude that lacrosse athletes saw statistically significant acute adaptations pre-to-post test in reaction time ($p = 0.01$) and eye-hand coordination ($p = 0.005$) following a sport-specific SVT training regimen. Qualitative trends towards improvement pre-to-post tests included eye-hand precision ($p = 0.07$), perceptual span accuracy($p = 0.088$), and reaction time percentile rank ($p = 0.067$). Retentive adaptations pre-to-post assessments were seen in perceptual span tests ($p = 0.013$).

Despite the limitations of this study, including small sample size and length of training program, the initial results demonstrate the effectiveness of SVT training. This concludes that any athlete that requires specific hand-eye coordination, memory, and reaction time, such as baseball, softball, hockey, lacrosse, and basketball, could benefit from regular training with SVT.

Future studies should aim to include larger sample sizes and extend training to at least 4-8 weeks to allow for more retentive visual cognitive abilities training adaptions to occur.

REFERENCES

1. Appelbaum, L. G., Schroeder, J. E., Cain, M. S., & Mitroff, S. R. (2011). Improved visual cognition through stroboscopic training. *Frontiers in Psychology*, *2*. https://doi.org/10.3389/fpsyg.2011.00276
2. Appelbaum, L. G., Cain. M. S., Schroeder, J. E., Darling, E. F., & Mitroff, S. R. (2012). Stroboscopic visual training improves information encoding in short-term memory. *Attention, Perception, & Psychophysics*, *74*(8), 1681–1691. https://doi.org/10.3758/s13414-012-0344-6
3. Burris, K., Vittetoe, K., Ramger, B., Suresh, S., Tokdar, S. T., Reiter, J. P., & Appelbaum, L. G. (2018). Sensorimotor abilities predict on-field performance in professional baseball. *Scientific Reports*, *8*(1). https://doi.org/10.1038/s41598-017-18565-7
4. Elliott, D., & Bennett, S. J. (2020). Intermittent vision and goal-directed movement: A Review. *Journal of Motor Behavior*, *53*(4), 523–543. https://doi.org/10.1080/00222895.2020.1793716
5. Hülsdünker, T., Rentz, C., Ruhnow, D., Käsbauer, H., Strüder, H. K., & Mierau, A. (2019). The effect of 4-week stroboscopic training on visual function and sport-specific visuomotor performance in top-level badminton players. *International Journal of Sports Physiology and Performance*, *14*(3), 343–350. https://doi.org/10.1123/ijspp.2018-0302
6. TRIFU, A., & Stanescu, M. (2021). The effects of using stroboscopic training on sports performance. *Discobolul – Physical Education, Sport and Kinetotherapy Journal*, *60*(2), 118–127. https://doi.org/10.35189/dpeski.2021.60.2.4
7. Wilkins, L., Nelson, C., & Tweddle, S. (2017). Stroboscopic visual training: A pilot study with three elite youth football goalkeepers. *Journal of Cognitive Enhancement*, *2*(1), 3–11. https://doi.org/10.1007/s41465-017-0038-z