SPORTS VISION TRAINING:
CURRENT DIGITAL OPTIONS

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Disclosure Statement:
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AREAS OF SPORTS VT

- Remediation of vision inefficiencies that may negatively impact performance consistency
- Attentional load theories
- Enhancement of visual information processing skills to facilitate rapid utilization of critical visual information
- Enhancement of cognitive functions
  - Visual decision making
  - Modulation of attention

Sequencing and Hierarchy

- Static to Dynamic
- Visual skill isolation to sensory integration
- Low stress to high stress
- Low cognitive to high cognitive
- Elevate visual skills above critical level

VARIABLES FOR SUCCESS

- Athlete/Patient Selection
- Delivery Models
  - Traditional office-based programs
  - Integration with other sports training programs
- Goals and Expectations

Welford Information Processing Model

Operational Memory
Expectation Based on Past Experience

Perceptual Mechanisms
Detection and Selection of Appropriate Inputs

Decision Mechanisms
Strategy Formation and Informational Selection

Effectors
Motor Controls
Operational Feedback
Intrinsic Feedback
Extrinsic Feedback
COMPONENT SKILL TRAINING

- The field of perceptual learning has demonstrated many examples of dramatic improvements in visual abilities from appropriately structured tasks.
- Practice leads to substantial gains in sensitivity that can last for months or years (Crist, Li, & Gilbert, 2001).
- Benefits can transfer to new, untrained contexts (Bavelier, Green, Prat, & Schiavi, 2012; Deveau, Jaeggi, Zordan, Phung, & Seitz, 2014).
- Traditional VT procedures use component skill training paradigms to improve specific visual functions, and have been modified and applied for sports.

Sample Training to Improve Visual Acuity & Contrast Sensitivity

- Blur interpretation activities – Bangerter Foils

Bangerter Foil Training Steps

- **Step 1:** Practice the activity without the foil goggles for a short period of time (e.g., 2-5 minutes).
- **Step 2:** Repeat the activity with the foil goggles for 5-10 minutes; work to increasing foil density – Change after 3-5 successes at a level
- **Step 3:** Remove the foil goggles and repeat activity for at least 5 minutes to maximize retention of improved performance.

Sample Training to improve Visual Acuity & Contrast Sensitivity

- Pitchback or ball machine while using balls/objects with colors, letters, etc.

**RevitalVision™**

- Revital Vision™ benefits advertised:
  - Ability to see better - in low light conditions
  - Enhanced vision - while driving and reading
  - Increase contrast sensitivity - 100% Increase in Contrast Sensitivity
  - Increase visual acuity - improve vision two lines on an Eye Chart on average
- Research support for improvements in VA & CS
  - No control/placebo comparison; effect retained after 12 mo

J Cataract Refract Surg 2009; 34:570-577

**ULTIMEYES**

- ULTIMEYES interactive computer app uses an algorithm to provide customized vision training to “improve visual acuity, contrast sensitivity and attention”
- Neuroplasticity technology synchronizes task reinforcement with the appropriate stimuli to improve brain plasticity and vision by:
  - alerting and orienting cues (sounds spatially located with visual targets)
  - training of executive attention (distractors progressively become more similar to tasks targets)
  - tasks designed to help with sustained attention (exercises become progressively longer with time)
ULTIMEYES

• UC Riverside baseball (19 position vs 18 pitchers)
  — 24 30-minute training sessions
• Results demonstrated improvements in both visual acuity (7 improved to 20/7.5) and contrast sensitivity
• Analysis of batting performance before and after the training program demonstrated a significant reduction in strikeouts (4.4% improvement) and a combined increase of 41.2 runs created
• When calculated in relation to the prevailing conference statistics using Bill James’ Pythagorean Theorem of Baseball, this led to an estimated 4–5 extra games won over the 54-game season

Game Vision™

• Formerly CP3 via GlassesOff app
  — “designed to challenge the brain’s image processing speed in order to achieve sharper vision focus faster”
  — Players identify flashing, near-threshold targets that vary in speed, size and contrast to progress through levels
  — Collinear facilitation
  — Prototype showed improvements in a wide range of visual tasks and overall enhancement in visual processing speeds


NeuroTracker

• Immersive three-dimensional Multiple Object Tracking intervention with added dual-task functions to increase cognitive load
• Tracking objects (balls) as they move through space – targets and non-targets
  — Analogous to tracking teammates & opponents
• Speed and object number are adjusted in a staircase procedure, with other tasks added
• “Customize” and “Pro” versions
  (Note: This is not Neuro Trainer)

NeuroTracker

• Research shows it can discriminate high-level from lower-level athletes, and that a brief training regimen with the program can produce improvements in sports-related ability
• Performance has been correlated with actual game performance in professional basketball players (assists, steals & assist-to-turnover ratio), and that training with this program can selectively transfer to improved small-sided game passing performance in university-level soccer players

Mangine et al., 2014; Romeas, Guldner, & Faubert, 2016

Brain Training Games

• BrainHQ partnered with TB12 to promote a sports-specific cognitive training module
• CogMed is promoting the use of their working memory training modules for athletes
• HeadTrainer app targets five areas of mental function specifically tailored to athletes
• Promising platforms, but no research at this time...
Lightboard-type Technologies

Most provide a platform of:
• Interactive computer-based programs
• Large touchboard or touchscreen monitor
• Training algorithms for peripheral eye-hand response speed
• Training algorithms for decision-based peripheral eye-hand response speed
• Training algorithm for split attention

Options:
- SVT (Australia)
- Wayne Saccadic Fixator
- BATAK Pro

Options:
- Vision Coach
- Sanet Vision Integrator
- Dynavision

Options:
- Senaptec Sensory Station
- FitLight

Options:
- Good test-retest reliability for evaluation
- Dynavision with other SVT on collegiate baseball players found that batting averages, slugging percentage, and on-base percentage were all improved as compared to the previous season when no vision training was performed (Clark et al., 2012)
- 6 weeks of preseason training with 3x/week during the season
- With collegiate football, concussion incidences during the four years studied were reduced relative to the four years prior to the implementation of the training programs (Clark, Graman, et al., 2015)

Options:
- A 6-week training study used Dynavision with youth field hockey players
- Dynavision was used both as an assessment tool and as one of five training stations – along with Eyeport®, Hart charts, P-Rotator, and the Vision Performance Enhancement Program
- Performance on the Dynavision assessment task and a functional field of view assessment task both improved compared to a control group, but there was no difference in the MOT assessment (a transfer task)

The Quick Board

- The Quick Board consists of a rubber mat positioned on the ground with sensor pads in five locations.
- The mat is connected to a control device that provides visual stimulus and feedback information about the movement responses.
- Four weeks of training with the Quick Board has been shown to produce significant improvements in foot speed, choice reaction and change-of-direction in moderately active adults. (Galpin, Li, Lohnes, and Schilling. J Strength Cond Res 2008, 22:1901-7)

Integrated Sensorimotor Batteries

- Senaptec Sensory Station
- Vizual Edge Performance Trainer®
- RightEye
- Most of the research has correlated performance on specific measures of vision with sports performance metrics.
- Training studies with these instruments demonstrate improvements in visual performance measures, but there are only preliminary studies designed to determine effects on sports performance.

Senaptec Sensory Station

- The Sensory Station was used as both a training tool and an evaluation benchmark in an applied program conducted by the University of Texas varsity softball.
- This intervention involved multiple weeks of SVT drills including practice with:
  - Strobe Eyewear, Marsden Balls, Brock Strings, and Near Far Charts, as well as the Depth Perception, Eye-Hand Coordination, and Go/No-Go tasks on the Sensory Station.
- Results from 15 athletes who underwent SVT and 10 teammates who did not indicate significant relative improvements for the SVT group in three Sensory Station tasks (Near-Far Quickness, Target Capture & Go/No-Go).
  - Appelbaum et al., 2016; Athletic Training & Sports Health Care. doi:10.3928/19425864-20160314-01

SPORT SIMULATION APPROACHES

- Computerized simulations and virtual reality (VR) platforms have gained substantial use as alternate means by which to simulate game action, allowing athletes to gain ‘mental repetitions’ that mimic actual plays being run in the first-person with little-to-no risk of injury.

SPORT SIMULATION APPROACHES

- Research with customized applications have evaluated the capacity to implement realistic sports-specific simulations of:
  - Baseball (Fink et al, 2009; Gray 2002, Zaal & Ht, 2011)
  - Tennis (Xu et al., 2011)
  - Ping pong (Oosterhuis et al, 2007)
  - Billiards (Coursтвержденк et al, 2007)
  - Archery (Byun et al, 2010)
  - Handball (Zelle et al, 2010)
  - Rugby (Miles et al, 2012)
• 17 football players ages from 7th grade to college
• Over a 3-day period, these athletes performed multiple repetitions on the SIDEKIQ™ football simulation, making pre-snap reads to identify the optimal receiver to throw the ball to on each play
• Over the course of the evaluation, individuals improved in their ability to make the correct passing decision by an average of 30%


• Learning literature proposes that transfer of skill training occurs best if the training and transfer tasks engage highly overlapping cognitive processes (Dahlin, Neely, Larsson, Backman & Nyberg, 2008)
• Naturalistic training situations that most closely resemble game situations might have the highest values in training practical athletic skills
• Technology innovations allow participants to practice actual or simulated sporting activities with altered or augmented visual information

Stroboscopic Training
• Strobelights/Strobe eyewear
  — Develops speed of visual processing
  — Slower flash rates require faster processing
  — Use w/pitchback, ball catching, practice drills, etc
• Strobe eyewear can be worn during sport performance to train sport-specific visual processing speed
Strobe Training Steps

- Step 1: Practice the activity without the strobe for a short period of time (e.g., 2-5 minutes).
- Step 2: Repeat the activity with the Strobe for 5-10 minutes; work to decrease flash rate — Change after 3-5 successes at a level
- Step 3: Remove the strobe and repeat activity for at least 5 minutes to maximize retention of improved performance.

Stroboscopic Training

- Stroboscopic training increased dynamic visual acuity (after one training session) and ball catching performance (over the course of the training) compared to training without a stroboscopic effect.
- The strobe group averaged an 18% improvement in on-ice skill performance from pretraining to posttraining, whereas the control group's performance did not improve.
- Stroboscopic illumination reduced the severity of motion sickness symptoms, and shutter glasses with a flash frequency of 4 Hz are as effective as a strobe light.

Senaptec Strobe (formerly Nike)

- Integration training applications for various sports — Baseball/Softball, Football, Soccer, Basketball, Volleyball, Skiing/Surfing, Golf, etc.
- Duke University vision cognition research (N=504)
  "Those who trained with the Nike Strobes showed greater improvements than those in the control group, revealing training benefits due to the stroboscopic experiences." VSS '11
  http://today.duke.edu/2011/05/nikestrobe

The Quiet Eye™

- Resenha et al. Stroboscopic Vision as a Treatment for Motion Sickness: Strobe Illumination vs. Shutter Glasses. Jour Spat Extens Inst ment 2009; 77(2-3).
QUESTIONS?

References

• Appelbaum LG, Erickson G. Sports vision training: A review of the state-of-the-art in digital training techniques. Int Rev Sport & Exercise Psychology 2016; DOI: 10.1080/1750984X.2016.1266376