The Tachistoscope
Its History & Uses

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Abstract

Tachistoscopic training, also known a Flash Recognition Training (FRT), is a perceptual enhancement technique designed to improve the recall of visual information. The speed and accuracy of this recall allows for integration of vision with prior experiences in an optimal manner. This article briefly reviews the history of the tachistoscope and some of the research that supports the efficacy of the tachistoscope as a diagnostic and training device. Its uses in optometry, law enforcement and military training and as a research tool in psychology are discussed, along with its application to sports vision.

Key Words

accuracy, automoticity, flash recognition training, law enforcement and military training, memory, perceptual speed, psychology, reading, sports vision, tachistoscopic training, visual recall

Introduction

Tachistoscopic training, also known as Flash Recognition Training (FRT) in some circles, requires an individual to gather visual information and immediately recall as much as possible about the information. A second phase requires the individual to express the derived information via verbal, written or keyboard computer means. The first tachistoscopes were essentially sophisticated shutter aperture devices that allowed precise brief exposures of images to appear on a screen. Tachistoscope is derived from the Greek words 'tachys' meaning swift and 'skopion' meaning instrument for viewing or observing. Most tachistoscopes were designed to allow exposures ranging from 2 seconds to 0.01 second duration. They also usually allowed for precisely timed intervals between exposures.[1] With modern technology, the basic tachistoscopes have been replaced with computer programs that generate exposure times with more gradations and variable time intervals allowing exposures as fine as .01 second differences between exposures. Computer technology allows more flexibility in FRT program design.

Visual recall is enhanced as the flashed images are either increased in number or complexity as exposure duration times are decreased. The protocol I use involves a grading system which provides feedback to the trainee concerning the accuracy of the responses. When at least 70 percent accuracy is achieved, the next level of difficulty is displayed for recall and response. The goal of the training is to increase the number and/or complexity of the visual targets while maintaining accurate recall. Often numbers have been used as the visual targets, and research has shown that humans have the capability of recalling correctly and in the proper sequence, eleven numbers exposed for a 0.53 second flash duration.[1]

This article will present a brief history of the tachistoscope and discuss its uses in optometry and other fields. It is hoped that this discussion will motivate optometrists to maximally utilize this instrument in their vision training programs and to become involved with other fields that have used it in the interest of optimizing various areas of human performance.

Background

In 1938, Bender used visual motor patterns, i.e., patterns that the subject views and then draws, as stimuli to illustrate a Gestalt function. She defined Gestalt as "that function of the integrated organism whereby it responds to a given constellation of stimuli as a whole; the process itself being a constellation, or pattern, or Gestalt." This can be interpreted as meaning that the whole is greater than the sum of its parts. She further discussed the use of the tachistoscope in experiments to reveal more fundamental features of the visual motor Gestalt. She wrote; "In summary, it seems that the use of a short term exposure of the form by the tachistoscope leans to the experiencing of more primitive forms which suggest that the temporal factor is important in total experience, and that the active relationship that exists between the observer and the stimulus, and which creates the visual

motor Gestalt or experience, requires an actual time unit for the creation, and that this temporal factor moreover results in a different type of Gestalt experience. If the time is insufficient, the pattern experienced is similar to that of a small child."[2]

It is unclear whether Bender's description of a more primitive type of Gestalt response results in a more unbiased visual motor response: one that is less influenced by expectation and prior experience, and results in a Gestalt form reproduction that is more representative of the observed stimuli.

The efficacy of tachistoscopic training dates back to research during the WWII era when the military was investigating training protocols to improve combat readiness. One study involved training pilots to better recognize enemy aircraft. Renshaw used tachistoscopic training to teach U.S. Navy pilots how to quickly and accurately recognize airplanes.[1]

In 1945, Renshaw used tachistoscopic training to demonstrate an increased functional visual proficiency in perceiving forms, sizes, positions and distances. He summarized that; "Tachistoscopic training with digit patterns produces marked increase in reading comprehension and speed, measured by standardized tests. It enlarges form fields, in the vertical as well as horizontal meridians, and assists in the reduction of myopia. Used in Naval Aviation, the method has made a useful contribution to the more accurate and speedy identification of airplanes and ships."[3]

Speed of perception research at the State University of New York, State College of Optometry College of Optometry (SUNY)

Between 1984 and 1987, speed of perception was studied by researchers at SUNY.[4-6] They proposed that speed of perception is a cognitive skill concerned with the rate of processing visual information. Speed of perception was among a number of visual abilities that were investigated while studying normally achieving readers in kindergarten through grade five. One of the conclusions that emerged from these papers was that perceptual speed as measured with the tachistoscope was significantly correlated with reading at all grade levels.[7]

An interesting outgrowth of the SUNY tachistoscope studies was that the researchers then time-normed the Grooved Peg Board and the Divided Form Board tests. By recording the time necessary to complete these tests these researches then discussed the relationship between accuracy and automaticity. Groffman and Solan reported that, "Efficient learning proceeds in the direction from accuracy to automaticity. As in reading and mathematics, automaticity reflects the ability of the child to rapidly integrate the necessary subskills."[7]

Groffman and Solan drew a very important conclusion on the importance of considering the temporal elements of visual-motor and visual perceptual learning by stating: "When the lower order perceptual and sensory-motor skills dominate the child's performance rather than serving as essential background in the organization of the visual percept, the child probably will not develop the expected level of automaticity and may not be ready to learn to read."[7]

In another study, Solan demonstrated that there exists a group of readers with above average abilities on standardized reading tests, yet complained that their reading was slow and inefficient. This group of readers showed substandard sequential tracking skills. Solan further concluded that "this special group of inefficient readers is easily helped by the optometrist. Training with the tachistoscope and Guided Reader (Instructional/Communication Technology, Huntington Station, New York, NY) an instrument customarily used to improve reading efficiency using a rectangular slot moving left to right, and projecting a portion of a film strip which can be read on a screen at a desired speed) provides rapid improvement in 15 to 20 hours. Eye movement recordings completed before and after training can confirm the patient's subjective impressions of increased reading efficiency."[8]

Working with children on tasks that provide sensory-motor feedback (i.e. visual-motor integration training) leads to levels of visual perceptual automaticity. The above optometric research gives evidence that tachistoscopic training can be an important tool to enhance one's ability to proceed from an accurate to an automatic level of visual processing.

Thus, the tachistoscope has been, and continues to be used in optometric practice, particularly as an extension to the remediation of visual dysfunctions.[9] In essence, it goes beyond the mechanical visual input parameters and is used to maximize basic aspects of visual processing and memory. It is used to enhance visual function in normal and compromised readers.

The emerging role of tachistoscopic training in military and police training

Another use of tachistoscopic training is predicted on the concept that during combat or stressful tasks requiring high degrees of mental workload, there is a tendency for humans to develop 'tunnel vision.[10,11] This perceptual narrowing response limits the extent of maintaining visual awareness of objects and targets located in peripheral field of view. This spatial constriction limits attention to peripheral visual information that may be necessary for survival or optimal performance.

Research has demonstrated that tachistoscopic training can increase the size of the peripheral field of view and reading speed. This ophthalmological study gave evidence that tachistoscopic training has the potential to teach individuals to process increased visual information more rapidly, and at the same time be more aware of a larger volume of visual space during a single glance.[12] This research can be interpreted as a reason to apply tachistoscopic training to marksmen so that they can more rapidly and accurately locate targets and counteract the above mentioned 'tunnel vision' that can occur during combat or stressful situations.

Although not directly related to tachistoscopic training, other research studies support the concept that enhancement of visual skills can have a positive effect in military related performances. For example, training mental imagery has proven to enhance marksmanship scores.[13] And another study conclusively links gains in visual function and pistol shooting performance following a three month visual training program[14] These last two cited studies are included to support the general concept that vision is a process that can be trained to enhance skills used during combat situations.

A prime example of the use of tachistoscopic training in police work (here called flash recognition training or FRT) began in 1985 at the Indiana Law

Enforcement Academy (ILEA). The goal of this program was to improve decision-making skills in 'deadly force' situations. Training continued through 1987 when the training board found the results of the FRT convincingly favorable as to recommend FRT become part of the curriculum.

Much of the initial design of the ILEA training program was modeled after the work of Rolland L Soule, Professor Emeritus of Police Science at the University of Louisville, Kentucky. One of his former students, Dale Vannatter, was primarily responsible for developing the FRT program for the ILEA. Professor Soule's experiences with FRT reinforced the concept that visual skills have a learned component and 30 hours (not to exceed 2 hours per day) of training was necessary for optimal learning to occur. He also postulated that "the purpose of the tachistoscope is to work on one's skill of perceiving in larger units. It is used to develop a larger span of recognition."[15]

The final design of the ILEA program consisted of a 30-hour course that extended over a seven week period. Training sessions lasted about one hour. Images alternated with sets of numbers (4 to 10 digits in length), pictures of crime scenes depicting shoot/don't shoot scenarios and words (single to groups of four words). During a one-hour training session, all three sets of stimuli were flashed for recognition. Exposure times started at $1/30^{th}$ of a second, and as training progressed, $1/100^{th}$ second of exposure times were used. Other aspects of training included in the daily training were visualization and concentration drills.

During the 30-hour training period, five tests were administered to trainees. One test before the program began, three tests during the 30-hour training period, and a final test upon completion of the FRT program. The tests were identical, and the results were used to measure the percentage of change between the first and last test.

Experience at the ILEA showed that students usually demonstrated one or two regression periods during the 30-hour training period. Regression periods were characterized by a temporary reversal of visual recognition skills. As the training continued, improvement occurred once again in most cases. To keep motivation high, ILEA recommended that accurate records of progress be kept and shown to trainees.

The ILEA staff believed that their program helped an officer to visually improve the ability to "identify, retain, perceive and react – quickly and decisively. More importantly, however, good visual skills could make the difference between life or death for the officer."[16]

What was most impressive about the ILEA course of training is that upon completion of the course, the ILEA staff reported that the trainees gained about 60% from the baseline in their ability to quickly and decisively deal with visual information in an accurate manner. "In a recent class of 126 students, the class improvement was 58%. Of interest to the students is how much of this sight and retention ability will they keep. Research by Dr. Samuel Renshaw and Professor Soule shows that 60-65% will be retained as the newly gained abilities are used on a daily basis. Improvement in sight and retention of information are put to work immediately even though it may be an involuntary act."[17]

The ILEA program was discontinued after the death of the program director, Dale Vannatter. Although her studies were not controlled studies, the pre-training and post-training results showed significant gains in retaining visual details of perceived images. It would be a service to the law enforcement community if researchers in optometry reproduce the ILEA program under controlled conditions.. Until that is accomplished, I propose that tachistoscopic training maintains its place as a proven and effective enhancement technique in law enforcement training.

The tachistoscope as a research tool in psychology

The tachistoscope has been used extensively in various psychological research studies. For example, a tachistoscope was utilized to deliver subliminal messages to measure their impact on eating disorders of women.[18] In a different study, a tachistoscope presented a meaningless series of consonants to subjects in order to investigate the idea that right hemisphere brain processing systems run along a physical code.[19] Another study used a tachistoscope to present images of faces showing positive or negative emotional expressions to either the right or left visual field. The results of this research indicated that positive facial images were identified more quickly then negative facial images when presented to the right visual field.[20]

A tachistoscope test was one in a series of tests measuring psychological behavioral effects on blood alcohol levels in male subjects. Repeated measured analyses of variance on each test indicated that the tachistoscope test added more sensitivity to the battery of tests than did digit span memory and the Archimedes Spiral.[21] The tachistoscope has also been used as a speed of perception screening test to detect organic mental disorders.[22]

Background masking provides evidence that perception is not instantaneous and that it occurs sequentially in distinct stages. The tachistoscope was used in a study to provide a series of targets for 50ms duration within a masking study. This novel visual stimulus demonstrated that backward masking can be modulated by voluntary visual attention.[23]

A psychological research paper measured the effect of exposure time upon perceived size. Ten subjects were exposed to circles for 100-1000msec by the tachistoscope, and then asked to compare the observed circles to circles of other sizes. The results indicated that exposure time has a role in the perception of size.[24]

A group of migraine headache and cluster headache patients and three control groups, age-education-and sex-matched, underwent a set of neuropsychological tests and tachistoscopic tasks to investigate cognitive function and interhemispheric balance. No significant differences became evident between patients and controls, and it was concluded that between attacks of headache no evidence of cortical dysfunction was recognizable.[25]

The use of the tachistoscope in sports vision

Sports vision involves using visual testing and training techniques to measure and/or enhance sports and athletic performance. The tachistoscope has played a role in sports vision research and training studies. One example of such a study involves vision screening of basketball officials. A tachistoscopic test was included in a battery of visual screening tests. Results indicated that the visual skills of offi-

cials were functioning at very high levels.[26]

Another study investigated sports vision training procedures. Office based visual training procedures included using the tachistoscope as a tool to train visual recognition and concentration. This study highlighted the importance of providing opportunities for athletes to practice visual skills essential to skillful sports performance.[27]

Summary

There is a rich history of effective tachistoscopic training in optometry, as well as in military and law enforcement courses. The best know example began with Dr. Samuel Renshaw of Ohio State University. He used his knowledge and leadership in training fighter pilots during World War II. Optometric research has also demonstrated the value of tachistoscopic training to promote automaticity of visual perceptual abilities to enhance visual function in normal and compromised readers. More recently FRT programs have been used in the training of law enforcement professionals. The tachistoscope has been used as a measuring and training device in many psychological studies. Today, tachistoscopic training continues as an integral part of visual remediation and enhancement by many optometrists. As other fields make use of the tachistoscope as one means to measure and improve visual performance, there is the opportunity for optometrists to apply their expertise to maximize the effectiveness of these programs. These opportunities exist in programs for the military and law enforcement personnel, in motor vehicle, aviation and sports performance, and as research consultants.

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