

**COORDINATION AND MOTOR SKILL (CAMS)
SCREENING AND TRAINING IN OUR SCHOOLS**
ROUGH DRAFT OF PAPER BY JIM CASSILY © 1995

CAMS EDUCATION CLASS 2001: FUNDAMENTAL COORDINATION AND SELF-CONTROL

The biggest challenge facing public education stems from the fact that when children first enter the public education system they already possess a wide variety of physical, mental and emotional strengths and weaknesses, both genetic and acquired. However, the recent implementation of high tech methods into our schools will soon dramatically expand our education professionals' diagnostic abilities, and allow them to create and institute much more personalized and effective teaching programs.

At the 1995 Chicago symposium on movement and the brain, Jacques d'Amboise and the world's leading neuroscientists agreed that teaching our children fundamental coordination and control over their own bodies is absolutely critical to their ability to "control their lives." Unlike correcting human genetic flaws, we already possess the knowledge and technology necessary to begin that process. Implementing fundamental Coordination And Motor Skill (CAMS) training in our schools is a scientifically logical way to help children correct their fundamental synaptic body control 'bad habits'; and thereby improve their desire and ability to learn in school.

A FRONT RUNNER OF 21ST CENTURY INTEGRATIVE EDUCATION

Breakthroughs in computer chip and digital audio technology led to the development of the world's first physically and aurally interactive metronome by Synaptec of Grand Rapids, Michigan. The original purpose of the Synaptic Training System (STS) was to help musicians and dancers master the rhythmic timing critical to their artistic craft. However, it quickly became obvious to its inventors, experts, therapists, educators, sports trainers and users alike, that this simple to use, yet high tech, learning tool has 'profound' human training and diagnostic capabilities that go far beyond its original intent.

The Synaptic Training System brings the now well known benefits of high tech computer interactivity to the physical, motor planning and sensory integrative related aspects of providing quality education. Simply stated, the STS helps children (and adults) to gain precise gross and fine motor control over their own bodies. The STS is:

- 1) systematically 'fun' (to help create the emotional desire to learn),
- 2) mentally, physically and emotionally interactive (to help synchronize and integrate),
- 3) able to provide real-time multi-sensory feedback (to assure direction and indicate progress),
- 4) repetitious (to ensure the creation of correct automated synapses), and
- 5) sequentially challenging, yet realistically achievable (to help children improve their sequencing skills, and to keep the learning process 'fun' for them).

IMPLEMENTING NEURO-MOTOR PROFICIENCY SCREENING IN OUR SCHOOLS

Optimally, our schools should begin implementing system wide CAMS training by analyzing every child's existing coordination and motor skill proficiency. However, such universal screening procedures will take time to implement. Meanwhile, the children with the most apparent problems (e.g. - a marked writing or speech difficulty) should be tested first and have prioritized access to corrective CAMS training.

The earlier we can diagnose CAMS problems and initiate corrective steps the better, however, there are two advantages to not instituting CAMS training to the overall population of 'normal' children until they reach the second grade. First, seven year olds typically are able to grasp the high tech CAMS training procedures somewhat faster than five year olds, thus reducing the instructional costs. Perhaps more importantly, by allowing the disadvantaged younger students with special problems undergo CAMS training one or two years before the 'normal' student population it will help them to better integrate into the mainstream. Doing so will improve their overall ability and desire to learn, and it will also improve their emotional self-image.

Draft 8/26/95

**The SYNAPTIC TRAINING SYSTEM and DIGITAL ANALYZER
by Synaptec**

The Synaptic Training System (STS) is designed to be: 1) mentally, physically and emotionally interactive, 2) systematically 'fun', yet repetitious, and 3) sequentially challenging, yet realistically achievable.

THE BASIC OPERATION OF THE SYNAPTIC TRAINING SYSTEM

- A) The STS generates a continuing series of reference beat sounds (ref-beats) which occur a consistent time period apart from each other, similar to a metronome;
- B) the ref-beat sounds are presented to the user via headphones or speakers;
- C) prior to responding, the user is instructed to listen to a number of ref-beats in order to become familiar with the time that elapses between the ref-beats;
- D) the user then begins to deliberately tap a limb (or move another body part), attempting to tap at the same exact time that each of the ref-beats occur;
- E) each time the user physically taps, a trigger attached to that limb sends a signal to the STS's computer processor which;
- F) analyzes exactly when in time each tap occurs in relation to the previous ref-beat, and whether it has occurred within the currently set millisecond 'Window Of Acceptable Accuracy' ('WOAA') range (For example: - a 100 ms. 'WOAA' setting would require the user to be within 100 milliseconds of correct center timing to be considered to be within the currently acceptable range);
- G) the STS transposes this timing information into an easily recognizable guidance 'pitch' sound (tap-sound) that changes according to user response's accuracy:
 - 1) if the user did not wait long enough before responding the tap-sound will be lower in pitch accordingly,
 - 2) if the user waited too long to respond, the tap-sound will be the higher the pitch accordingly, and
 - 3) if the user's response occurred within the currently set 'WOAA' range his tap-sound will be a recognizably different reward sound;
- H) the transposed guidance tap-sound also moves to the right or left; left for too early, right for too late, and center when the tap is within the currently set 'WOAA' range;
- I) the STS instantaneously amplifies the transposed user guidance tap-sound, mixes it with the ongoing series of ref-sounds, and concurrently feeds it back to the user via the headphones or speakers;
- J) the user consciously hears each of his transposed guidance tap-sounds mixed in with the ongoing ref-beats;
- K) the STS's changing aural guidance sounds 'push' or 'pull' the user's movements toward the 'WOAA' timing correctness; and
- L) keep them there for increasingly longer periods of time so that timing correctness can be experienced and imprinted on their permanent neuro-motor memory.

HOW THE STS COORDINATION AND MOTOR SKILL (CAMS) DIGITAL ANALYZER WORKS

All Synaptic Training System measurements and numerical indications of user accuracy are derived from measuring and/or testing procedures done on the STS and are referred to as "STS Standardized Measurements". (Note: Prior to beginning training, each trainee is given the following STS Standard Test Battery and the results are stored on the computer or noted for future reference and STS training use.)

The following is a description of how the STS functions as Standardized CAMS analyzer:

- A) The 'WOAA' range function is inactivated during analysis and there will be no 'WOAA' reward sounds received by the user;
- B) for one minute the user is required to continuously tap a particular limb in order to indicate exactly when the correct length of time has elapsed after each of the previous ref-beats;
- C) at the end of the one minute test period the STS sounds will stop and an exact digital measurement number will be displayed on the computer screen that represents the user's STS Standardized CAMS Accuracy for that particular body part being analyzed (e.g.: the user would have an STS CAMS Accuracy of 85 ms. for that particular body part involved);
- D) at the end of the predetermined battery of different body part tests, the STS will display on the computer screen a list of tests followed by a STS Standard Accuracy Measurement (SAM) for each body part;
- E) the screen can also display a series of different style graphs which help to visually illustrate the results of the entire STS Standardized Test Battery (NOTE: the trainer can also select and display STS stored population norms and other helpful information on the screen for comparison and analysis);
- F) the trainer can print out the complete STS Standardized Test Battery on a printer and/or store that user's data, and other pertinent information, in the computer's memory for tracking and/or data collecting purposes; and
- G) at the beginning of that user's first STS training session, the trainer need only select the user's name and select Start New Session, the STS program will preset to the user's optimum settings according to that user's STS Test Battery results, and display the starting priority of limb training to be done.

HOW THE STS COORDINATION AND MOTOR SKILL (CAMS) TRAINING SYSTEM WORKS

The Synaptic Training System computer program automatically adjusts to each trainee's abilities and optimum speed of CAMS learning, and it promotes success rather than failure. Above all else, its most important single feature is that it is a lot of fun to use.

The following is a description of how the STS functions as a neuro-motor control and coordination training system:

- A) Prior to beginning each user's first training session the trainer will select the trainee's name from the STS computer Test Battery file and select First Training Session Set-up.
- B) The STS program will automatically adjust to the user's optimum settings according to that user's initial STS Test Battery results, and display on the screen the starting priority of limb training (the STS Test Battery settings can also be input manually according to the trainer's notes),
- C) the trainee begins to deliberately tap the limb indicated on the computer screen along with the ref-beats;
- D) each time the trainee taps that limb he will consciously and concurrently hear each of his transposed tap-sounds mixed in with the ongoing series of ref-beats in the headphones (or speakers);
 - 1) if the user did not wait long enough before responding after the previous ref-beat, the tap-sound will be lower in pitch accordingly,
 - 2) if the user waited too long to respond, the tap-sound will be the higher the pitch accordingly, and
 - 3) if the user's response occurred within the currently set 'WOAA' range his tap-sound will be a recognizably different reward sound;
- E) the transposed tap-sound will also move to a left to right 'location' in the headphones that also represents the tap's accuracy; left for too early, right for too late and center for within the 'WOAA' range;
- F) as the trainee continuously taps the STS program will continuously adjust the 'WOAA' range to allow the user to receive the reward sound more often than the guidance tap-sounds;
- G) whenever the user's taps falls out of the 'WOAA' range the STS changing aural guidance tap-sound will 'push' or 'pull' their next movement back toward the 'WOAA' timing correctness';
- H) as the user's timing accuracy improves the 'WOAA' range is systematically narrowed by the STS program;
- I) the computer will notify the trainee (and/or trainer) when it is optimum to end each training session and the STS program will keep the 'WOAA' range at the narrowest point where the user can consistently stay within 6 to 8 times in a row before falling out, (this allows that sessions improvements to be permanently imprinted on the trainee's permanent neuro-motor memory);
- J) the series of 30 to 45 minute (one per day) STS training sessions should continue until the trainee reaches their optimum genetic and physical neuro-motor and coordination efficiency, typically 6 to 12 sessions. Optimally, the complete STS CAMS training program should be kept to under a month.

THE TYPICAL STS TRAINING SEQUENCE

The trainee is scheduled to begin her first training session after her initial STS Test Battery. Before the Test Battery begins she is given a quick introduction and demonstration to show her how much fun STS training is and allow her to get familiar with the STS's changing sounds. Immediately thereafter she is given the twelve minute STS Standardized Test Battery to determine the neuro-motor control accuracy of each of her limbs. The test battery includes:

- 1) both hands clapping together, 2) left hand, 3) right hand,
- 4) both toes alternately tapping on a floor trigger, 5) right toe, 6) left toe,
- 7) both heels alternately tapping on a floor trigger, 8) right heel, 9) left heel,
- 10) right hand & left toe, and 11) left hand & right toe.

The Test Battery pre-sets the starting parameters for the trainee's first training session. The trainee takes a 5 to 10 minute break before her training session begins.

During her first training session she works on each of her limbs, according to their STS indicated priority needs. The trainer helps her to deliberately force her tap to be very early and very late. This allows her to clearly hear her tap sounds moving back and forth from side to side in the headphones, and helps her recognize its changing guidance tones. (Note: Trainees typically exhibit facial expressions and jerky motions that are indicative of the internal argument they experience when, for the first time, they actually hear their existing motion 'bad habits'. However, the experience quickly changes into a fun and challenging internal learning game for them.)

Typically, the second session begins by helping the trainee break her 'synaptic bad habit' (tendency) of continually tapping too early (100 milliseconds early as per her STS Test). Again, the trainer helps her to very consciously 'force' her motions to be early and late in order to make her tap sound go back and forth to both sides in the phones. When she gains enough gross motor control to consistently move her tap from side to side, she is then instructed to deliberately keep it on the side opposite of where her 'tendency' is. After a short period of time, she learns to relax her 'aim' and let her tap automatically move toward 'WOAA' center correctness. If her tap goes past center and ends up back on her tendency side, she simply learns to move it back to the opposite side and repeats the process. Training after this point becomes primarily self-administrable, the trainer need only be there near the end of each subsequent session.

During subsequent sessions the STS program guides the trainee to work on the limbs that have the worst accuracy first, in order to synchronize her left/right control. As she learns to relax and 'not' aim, her highly accurate autonomic hearing and timing capabilities begin to use the STS sounds to correctly direct her physical motions. The STS 'WOAA' reward range automatically narrows as her accuracy and consistency improve.

As a typical trainee, she started at a 'WOAA' range of about 100 milliseconds either side of the beat. Shortly after gaining gross motor control (below 50 ms.), she learns to recognize and maintain the state of mind and fine motor physical control that allows her to stay close to the beat and to make quick, smooth adjustments in her timing. Once that is achieved, she quickly learns to 'sense' when she's wavering from center correctness and subconsciously make very minor adjustments without falling out of 'WOAA' center.

Each STS trainee's goal is to repetitively 'experience' performing with a correct CAMS proficiency of below 35 milliseconds. By doing so for a relatively short period of correct repetitions, existing synaptic 'bad habits' are corrected and new correct synaptic brain connections are created. Thus, the achieved CAMS improvements are permanently imprinted on the trainee's neuro-motor memory.

TYPICAL STS TRAINING RESULTS

Regardless of the trainee's impairment, highly specialized skill or age level, STS CAMS training results are consistent. Most trainees will quickly demonstrate a noticeable improvement in their fundamental body control and overall coordination. With the exception of severely handicapped trainees, STS trainees typically achieve a permanent fine motor control proficiency over each of their limbs of 35 milliseconds or better.

Systematically mastering precise fundamental control over their limbs corrects many of an STS trainee's existing fundamental movement synaptic 'bad habits'. It also adds new correct subtask brain connections to their foundation of stored correct synapses. This makes the process of learning each future complex physical task much easier and faster for them. Due to the strong neuro-synaptic inter-relationship between the brain's motor, cognitive and communication functions, noticeable improvements often occur in all three areas.

STS training gives humans more self-confidence, especially in their own physical abilities, and thus they have a broader freedom of choice as to which activities they participate in. They no longer deliberately or subconsciously will have to avoid skilled activities just because they see themselves as a "klutz".

Having excellent body control doesn't mean STS trainees can just run out, buy tennis rackets, and instantly become world tennis champs. They still must learn the specific mechanics and mental control needed for whatever complex skill they want to master, to say nothing about building up the proper muscles. However, having a strong CAMS proficiency gives them the opportunity to rationally choose whether or not they do so.

ADVANCED STS CAMS TRAINING NOTES

The standard STS can also be used for advanced CAMS training programs. It allows trainees to also learn to tap with a small strobe reference light instead of the reference beat in their headphones (their own tapping and the 'WOAA' reward sounds are still heard). An optional small tactile reference pad ("The Thumper") can also be attached to the body, which allows trainees to 'feel' the reference beat instead of hearing or seeing it. These advanced CAMS exercises help trainees correct synaptic timing errors relating to their senses of vision and touch, and synchronize them with their sense of hearing. They improve their overall eye-to-hand coordination and sensory integration.

SCIENTIFICALLY EXPLAINING THE UNPRECEDENTED STS TRAINING 'EFFECT'

The patented STS real-time aural guidance system allows trainee to respond much faster and more accurately than previous neuro-motor training systems which were primarily based upon the use of visual stimuli and after-the-fact feedback. On the basis of evoked potential, auditory evoked responses are typically ten times faster than visual evoked responses in humans. Studies which use electrodes placed on the scalp to register neuro-activity clearly indicate that it takes 100 milliseconds for the brain to evoke a response after being presented with a visual stimuli, yet the brain evokes a response in only 10 milliseconds after being presented with an aural stimulus. That means the human hearing mechanism responds ten times faster than the visual mechanism.

The disparity in the brain's evolved visual and aural processing times is likely related to the physical fact that visual stimuli tend to emanate from fairly stable, relatively slow moving material objects and aural stimuli tend to emanate from rapidly moving and transient air waves. For the same reason, human vision also takes a longer time to recover from a typical related stimulus than human hearing does.

SYNAPTIC TRAINING SYSTEM (STS) BETA PRE-TESTING SUMMARY

Before initiating the STS beta training sessions, over three hundred individuals, with differing backgrounds and motor skill capabilities, were analyzed to establish average STS numerical CAMS norms typical of (non-STS trained) humans. The test battery analyzed each subject's motor control over each of their limbs and took about ten minutes to complete. Some of the initial results were as follows:

- The average STS CAMS test battery accuracy of the initial 330 untrained subjects was approximately 85 milliseconds.
- The subjects' left and right limbs were typically 10 ms. or more out of sync with each other, and their feet were much less accurate than their hands.
- Successful motor skill related professionals, such as athletes and music teachers, typically tested at 32 ms. or better (a baseball pitcher and tennis player tied for lowest at 15 ms.).
- Children and adults with severe motor skill impairments (including DCD) typically tested at 175 ms. or worse (several tested well above 250 ms.).
- 99.7% of all subjects over-anticipated the beat and consistently stayed ahead of it.
- Typically, the worse a subject's motor development impairment, the farther they were out in front of the beat.
- Prior to testing, most subjects accurately predicted what their own coordination abilities would be on a scale of: good, above average, average, below average or poor.
- A majority of subjects said their coordination was 'below average' or worse.
- A surprisingly high number of subjects said they avoided playing sports, dancing and most other skilled physical activities altogether, because they were embarrassed about their lack of coordination.

OPTIONAL STS SPECIALIZED PROGRAM EXPANDERS & TRIGGERS

The following highly specialized Synaptic Training System program expansions and triggers are currently under development and will soon be available:

- For K-12 Education
 - System wide progress tracking program expander,
 - CAMS group cooperation training games and triggers,
 - Touch guidance feedback pad (The Thumper) for sensory integration,
 - "Hop scotch" type floor trigger, and
 - Two-way wireless FM transmitters and triggers.
- For Occupational, Developmental and Rehabilitation Therapy;
 - Specialized therapy program expanders,
 - Specialized limb, torso and facial muscle triggers,
 - Specialized tactile guidance feedback pads for the blind and deaf, and
 - Multi-limb walking and aquatic triggers.
- For Sports;
 - Specialized single sport program expanders,
 - Long range, two-way, multi-function, wireless FM transmitters and triggers,
 - Football - Quarterback/Receiver practice synchronizer & helmet headphones,
 - Baseball - Batting eye-to-hand coordination trigger,
 - Basketball - Free throw practice hoop trigger and amplified court speakers,
 - Swimming - Aquatic triggers and headphones,
 - Aerobics & Physical Fitness - scheduled use timer,
 - Golf - practice tee trigger, and
 - Tennis - serve practice trigger.
- For Music, Dance, Theater and Film;
 - Specialized music and dance program expanders,
 - Musical instrument triggers,
 - Dance triggers,
 - Group synchronization triggers,
 - MIDI compatibility adaptors, and
 - Beat Averager for syncing with prerecorded (non-MIDI) music.
- Custom triggers and program expanders can also be designed, built and/or adapted by to meet other special training and therapy needs.

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