

AN OT's Toolbox : Making the Most out of Visual Processing and Motor Processing Skills

Presented by Beth Kelley, OTR/L, MIMC

FOTA 2012

By Definition

- Visual Processing

is the sequence of steps that information takes as it flows from visual sensors to cognitive processing.¹

- Motor Processing is synonymous with Motor Skills Disorder which is any disorder characterized by inadequate development of motor coordination severe enough to restrict locomotion or the ability to perform tasks, schoolwork, or other activities.²

1. http://en.wikipedia.org/wiki/Visual_processing

2. <http://medical-dictionary.thefreedictionary.com/Motor+skills+disorder>

Visual Processing

What is Visual Processing?

What are systems involved with Visual Processing?

Is Visual Processing the same thing as vision?

Review general anatomy of the eye.


Review general functions of the eye.

- Visual perception and the OT's role.
- Visual-Motor skills and why they are needed in OT treatment.

What is Visual Processing

“Visual processing is the sequence of steps that information takes as it flows from visual sensors to cognitive processing¹”

1. http://en.wikipedia.org/wiki/Visual_Processing



**What are the systems
involved with Visual
Processing?**



12 Basic Processes are as follows:

- 1. Vision**
- 2. Visual Motor Processing**
- 3. Visual Discrimination**
- 4. Visual Memory**
- 5. Visual Sequential Memory**
- 6. Visual Spatial Processing**
- 7. Visual Figure Ground**
- 8. Visual Form Constancy**
- 9. Visual Closure**
- 10. Binocularity**
- 11. Visual Accommodation**
- 12. Visual Saccades**

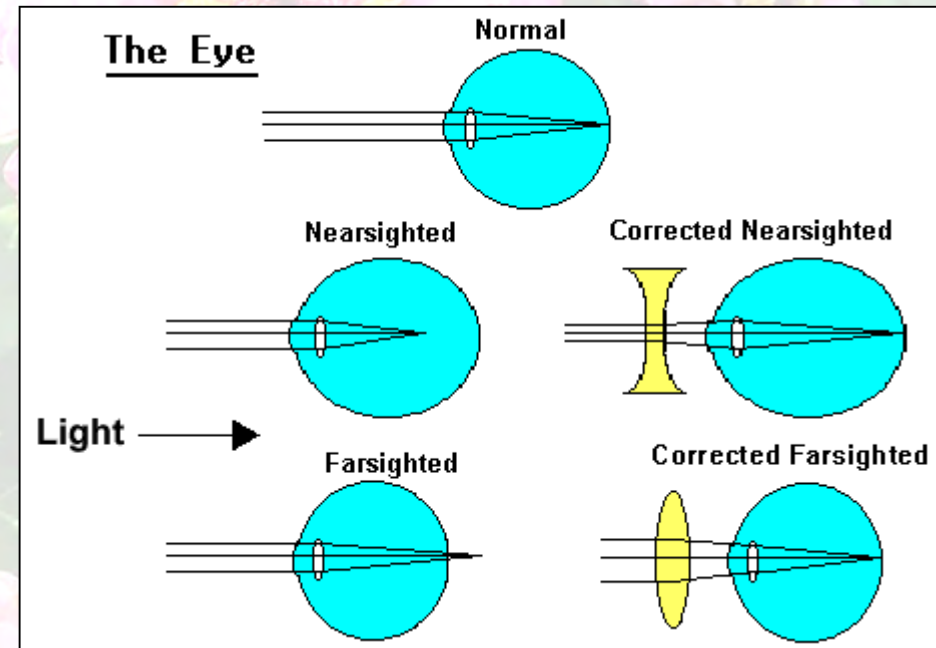
12 Basic Processes are:

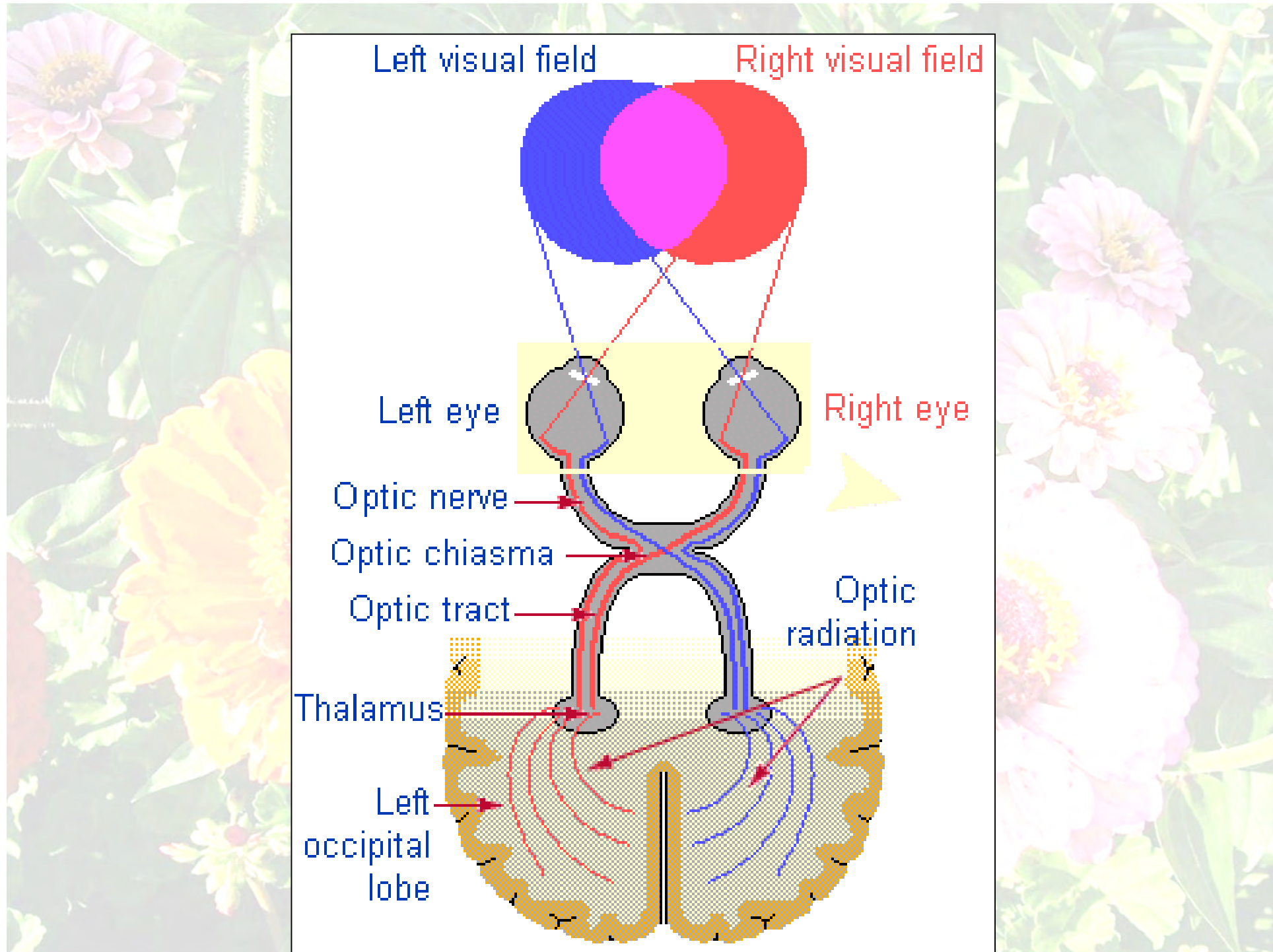
1. ***Vision***



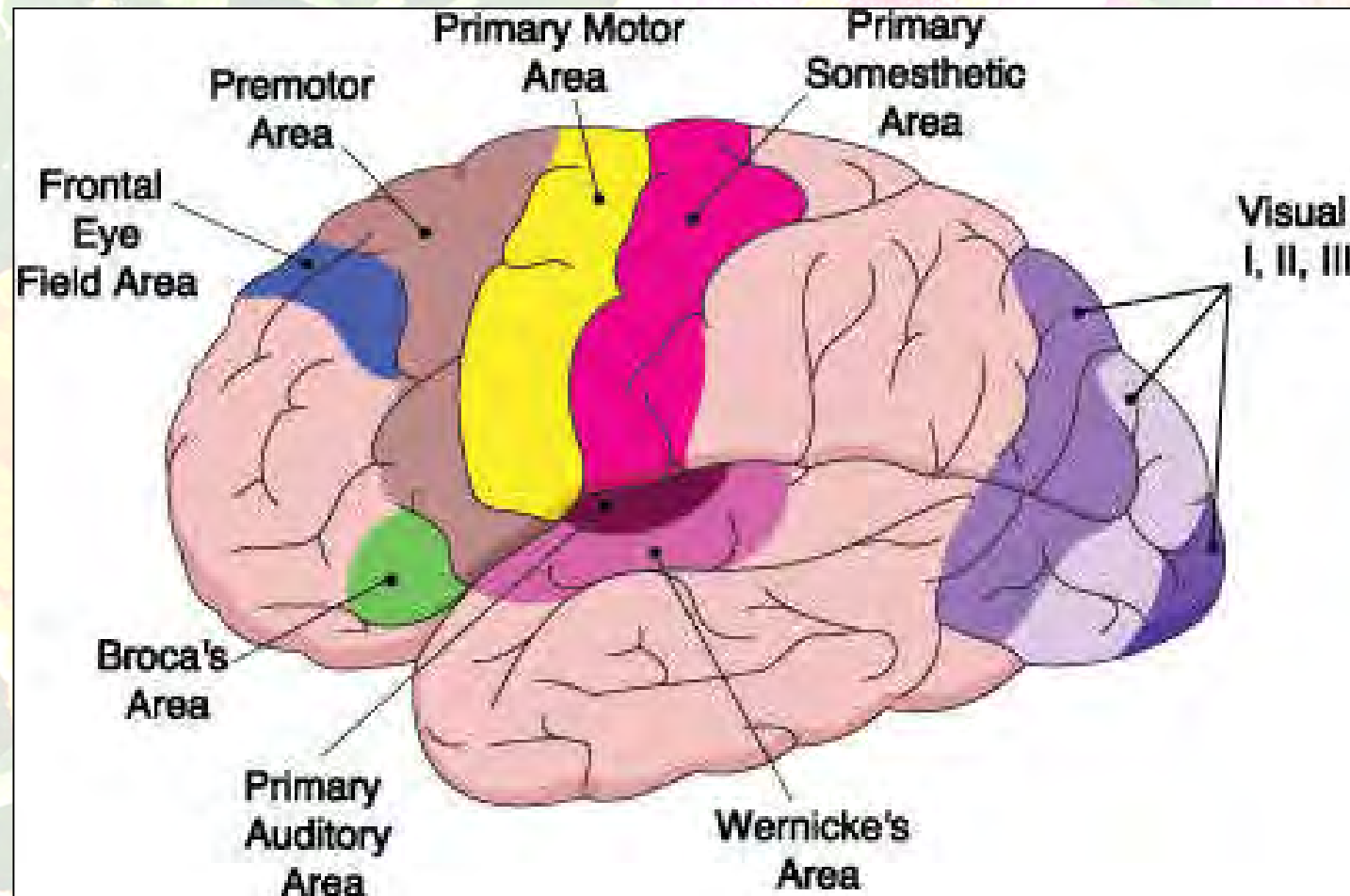
Vision

- The faculty or state of being able to see.
- The act or power of sensing with the eyes; sight.





The Anatomy of Vision





6 stages in Development of the Vision system

Birth to 4 months

4-6 months

6-8 months

8-12 months

1-2 years

2-3 years

At birth babies can see patterns of light and dark. During the first 4 months a baby will begin to follow slow moving objects and be able to recognize facial expressions.



4 – 6 - months control of eye movement develops further as the baby learns to turn from side to side.



6 – 8 - months both eyes are focusing equally.



8 – 12- months babies are more mobile, crawling helps to develop hand eye coordination, and as depth perception is still developing tumbles and falls are common.

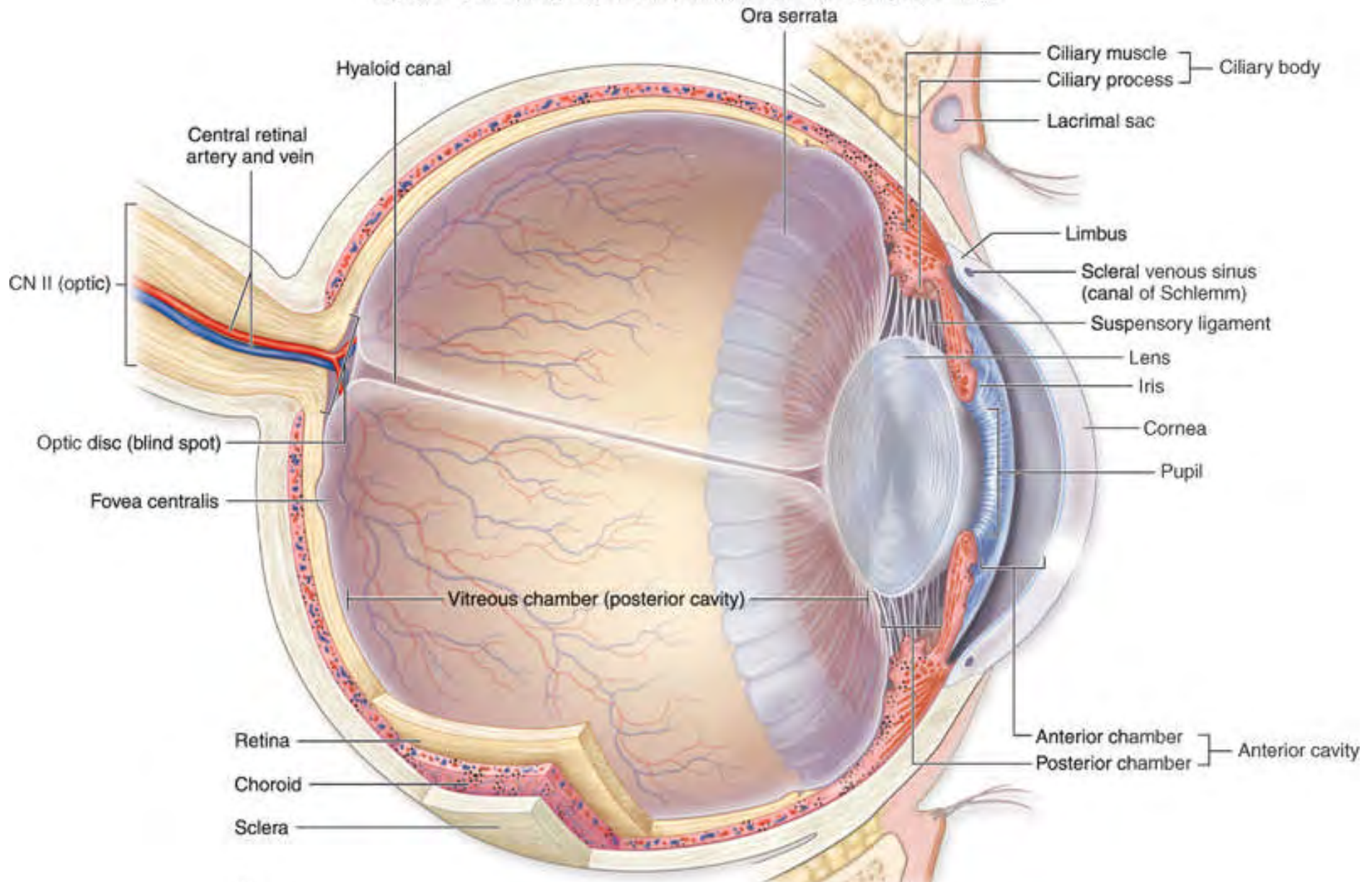


1 – 2 - years coordination of eyes and hands is well developed.



2 – 3 years – useful activities are reading and telling stories to improve your child’s ability to understand visual information and to prepare for learning to read.





(b)

Accommodation of the lens

A change in the curvature of the lens, accommodation is carried out by the ciliary muscles surrounding the lens contracting. This narrows the diameter of the ciliary body, relaxes the fibers of the suspensory ligament, and allows the lens to relax into a more convex shape. A more convex lens refracts light more strongly and focuses divergent light rays onto the retina allowing for closer objects to be brought into focus.^{1,2}

1. Saladin, Kenneth S. *Anatomy and Physiology: The Unity of Form and Function*. 5th ed. New York: McGraw-Hill, 2010. 620–22.

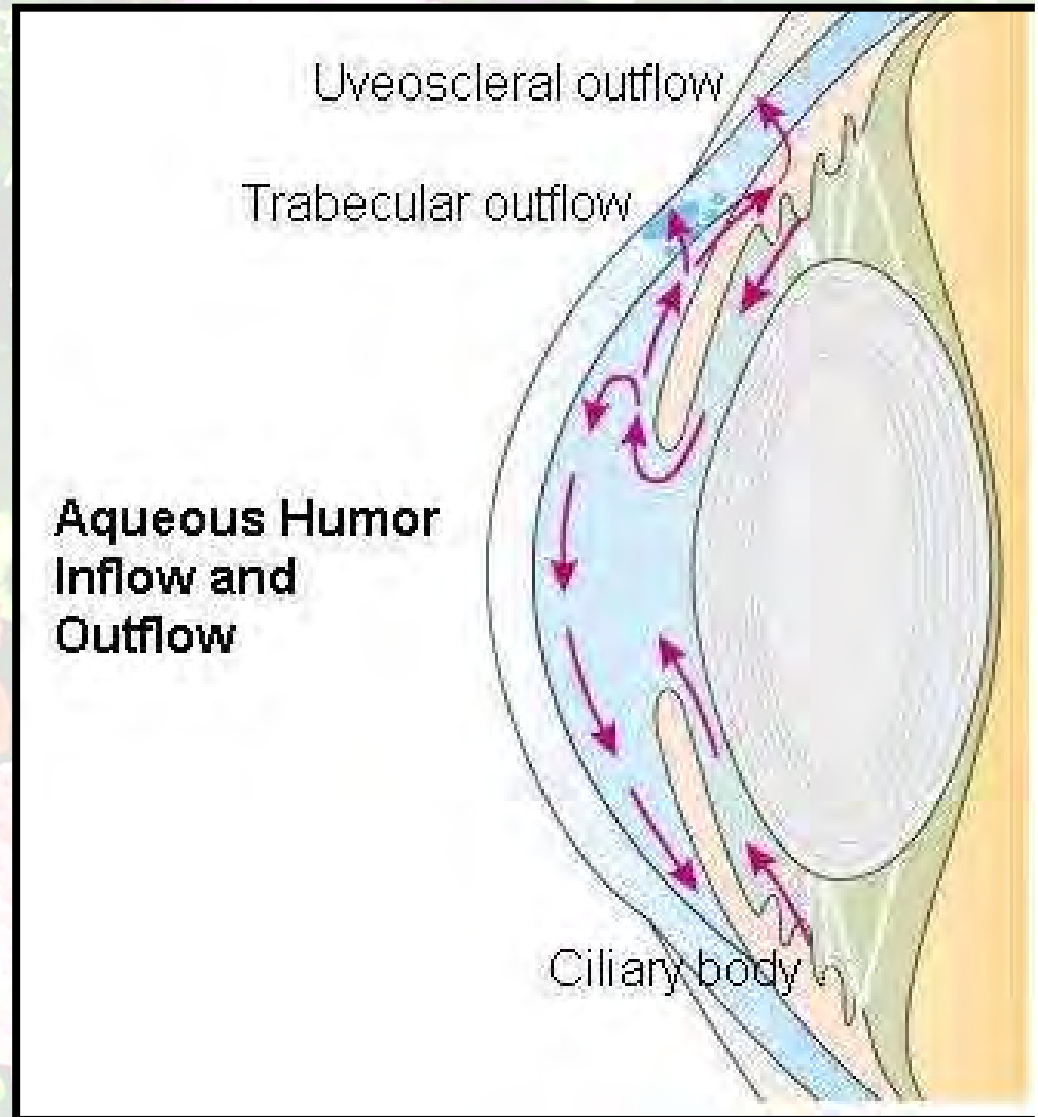
2. "human eye." *Encyclopædia Britannica*. 2010. *Encyclopædia Britannica Online*. 05 Dec. 2010 >.

<<http://www.britannica.com/EBchecked/topic/1688997/human-eye>>

Aqueous Humor

The Ciliary Muscle Body has 3 main Functions and 1 associated function.

1. Accommodation
2. Aqueous Humor production
3. Maintenance of the lens zonules
4. And anchoring the lens in place

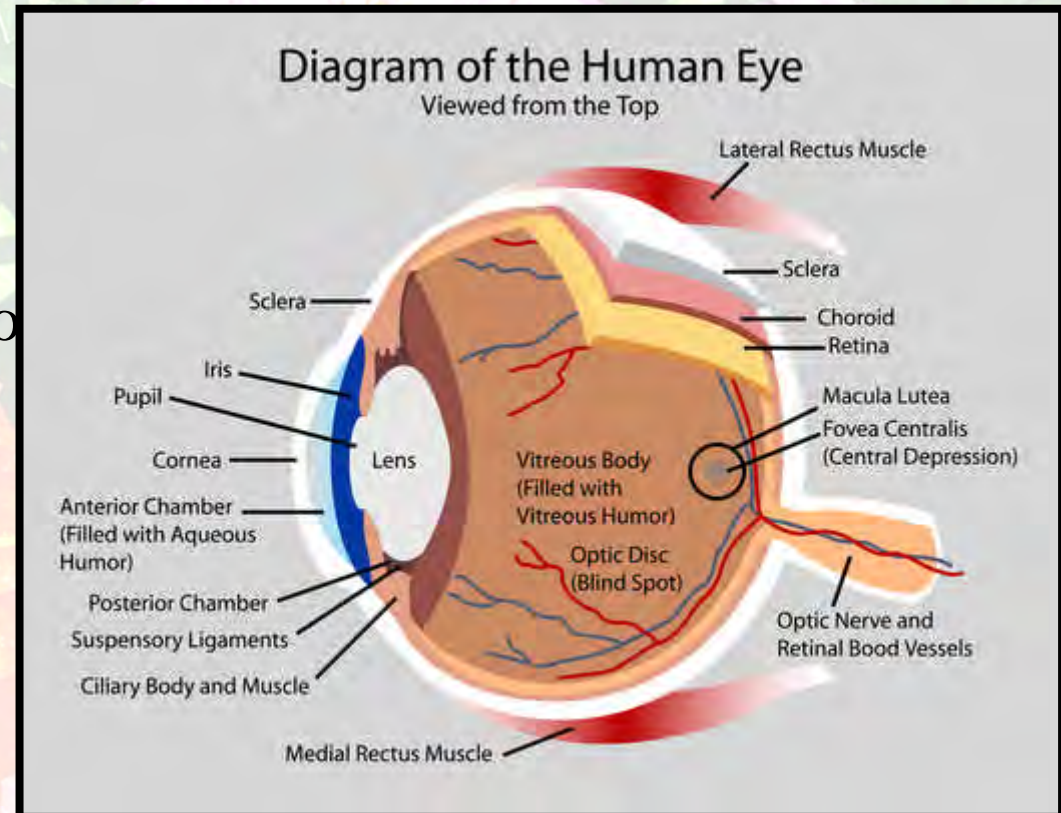


Vitreous Humor

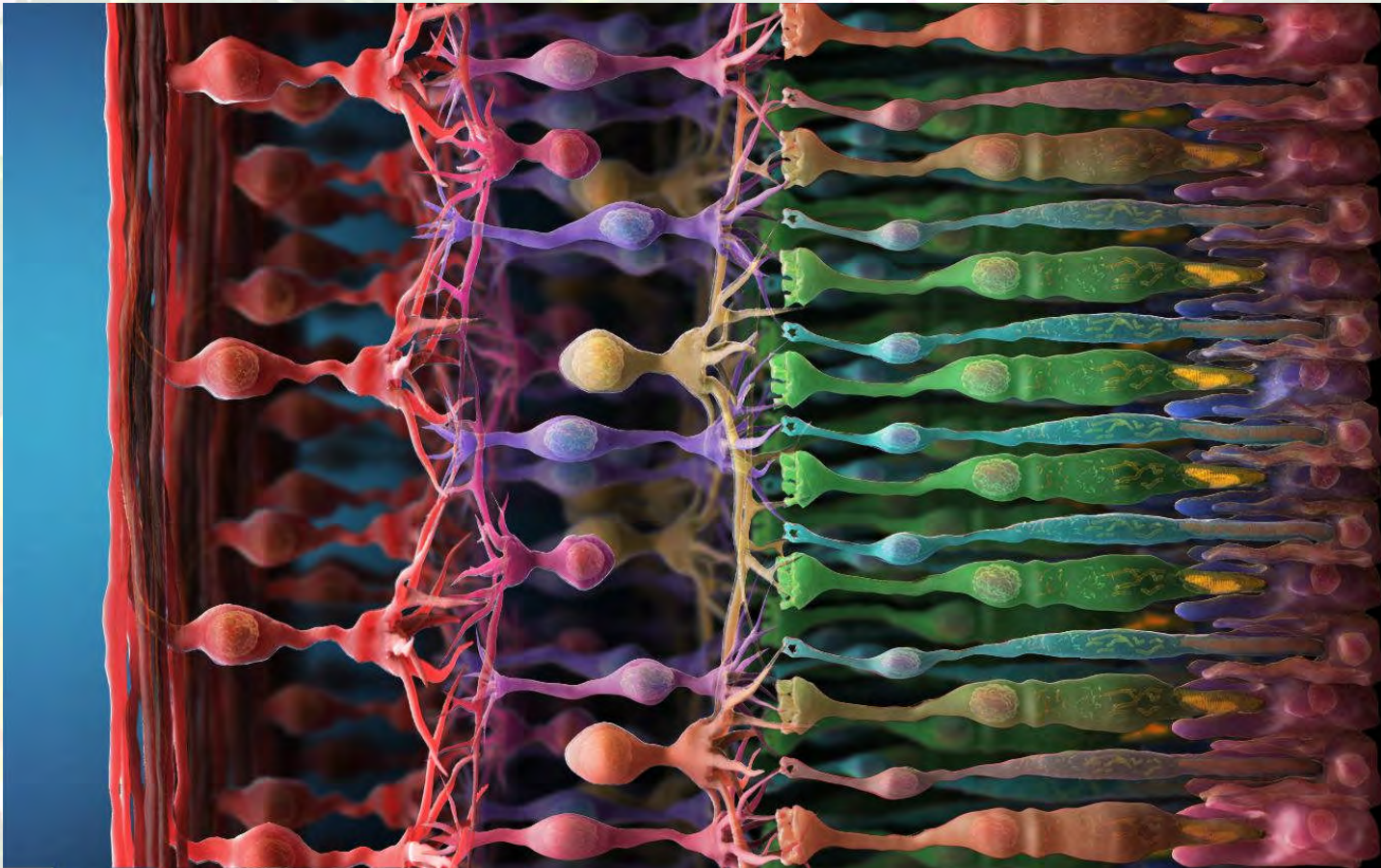
The vitreous pushes against the retina and helps hold it in place, but is only connected to the retina in three places:

Around the retinal periphery
At the macula (small central area that provides our sharpest vision)

At the optic disc (where the optic nerve leaves the retina)



Importance of Rods and Cones



“**Rod cells**, or **rods**, are photoreceptor cells in the retina of the eye that can function in less intense light than can the other type of visual photoreceptor, cone cells.

Rods

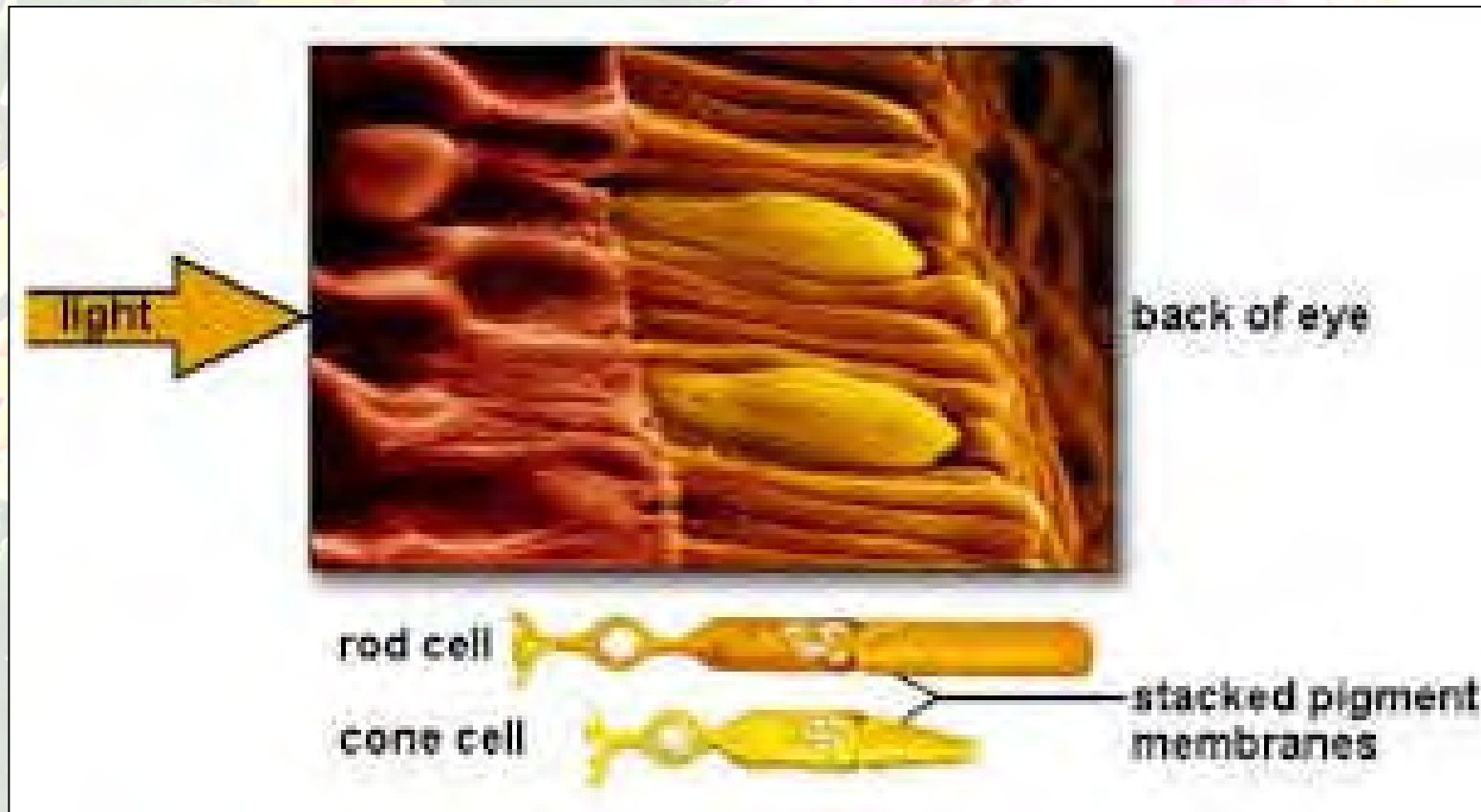
Are spread evenly across the retina but there are none in the fovea.

Rod cells are sensitive to low light intensities, so are made best use of at night.

Cones

There is a higher concentration of cone cells in the fovea.

They are more sensitive to high light intensities and therefore color can not be seen very easily when it is dark.



12 Basic Processes are:

1. Vision

2. **Visual Motor
Processing**





Visual Motor Processing

Visual-motor integration is eye-hand coordination, and is required for tasks such as writing and copying material, handwriting manual and cursive, pencil-paper tasks, copying from the board, and drawing.

Visual - Motor Processing

Symptoms:

1. Letter reversals
2. Difficulty following a map
3. Complains eyes hurt
4. Moves head when reading across page or holds paper at odd angles
5. Closes one eye while working
6. Yawning
7. Cannot copy from board to paper accurately
8. Loses place frequently
9. Does not recognize an object/word if only part of it is shown
10. Holds pencil too tightly
11. Struggles to cut or paste
12. Misaligns letters; may have messy papers

Before Visual & Motor Processing

^a
 A a b c d e f g h i j k l
 m n o p q r s t u v w x y z (1.20 min)
Capital
 A B C D E F G H I J K L
 M N O P Q R S T U V W
 X Y Z (1.11 min)
 0-20
 1 2 3 4 5 6 7 8 9 10
 11 12 13 14 15 16 17 18
 19 20 (54s)
 The quick brown fox jumped over the lazy dogs.
 The quick brown fox jumped over
 the lazy dogs (52s)

After Visual & Motor Processing Skills

Before / After visual and motor processing training
 7/9/12 / 4/5/12
 (Upper case) A B C D E F G H I J K L M N O P Q R S T U V W X Y Z (1.13 sec / 58 sec.)
 (improved: 13 sec.)
 Lower case] a b c d e f g h i j k l m n o p q r s t u v w x y z (56 sec. / 80 sec.)
 (improved by 24 sec.)
 0-20] 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 (42 sec. / 54 sec.)
 (improved by 12 sec.)
 Copy sentence] The quick brown fox jumped over the lazy dogs.
 The quick brown fox jumped over the lazy
 dogs (46 sec / 52 sec.)
 (improved by 6 sec.)

EXAMPLES of writing skills
Before and After Visual processing and
Motor processing

Before Im

4/5/12

I like computers because
it can do anything. It's like your
Brain I can also play games. I can
also research about the world. It
can do more thinking than your
brain does. (3:02 min)

drops pencil x3.

After Im

7/16/12

Write short sentences copy now anything.
U.S. Imposes new rule to tighten visa for Iran.

Presidential rivals trade charges of lies, financial cuts
for apology over 'Edony' remark

Panetta reports on Iran's military capabilities, states
Republican criticism over Obama.

A 9-year-old saved a younger girl from drowning at
a swimming pool in Massachusetts town.

A vehicle flipped in Burton Park, Kentwood in a Friday
morning wreck that shut the road for nearly an hour.

Lawmakers finish over China-made U.S. Olympic uniforms

A 23-year-old Sanford woman is recovering in a
hospital after being trapped in her car for three days.

The Marine Corps' Great Drill Platoon must, at
the Marine Corps War Memorial in Arlington, VA.

7/12 No episodes of dropping pencil noted.

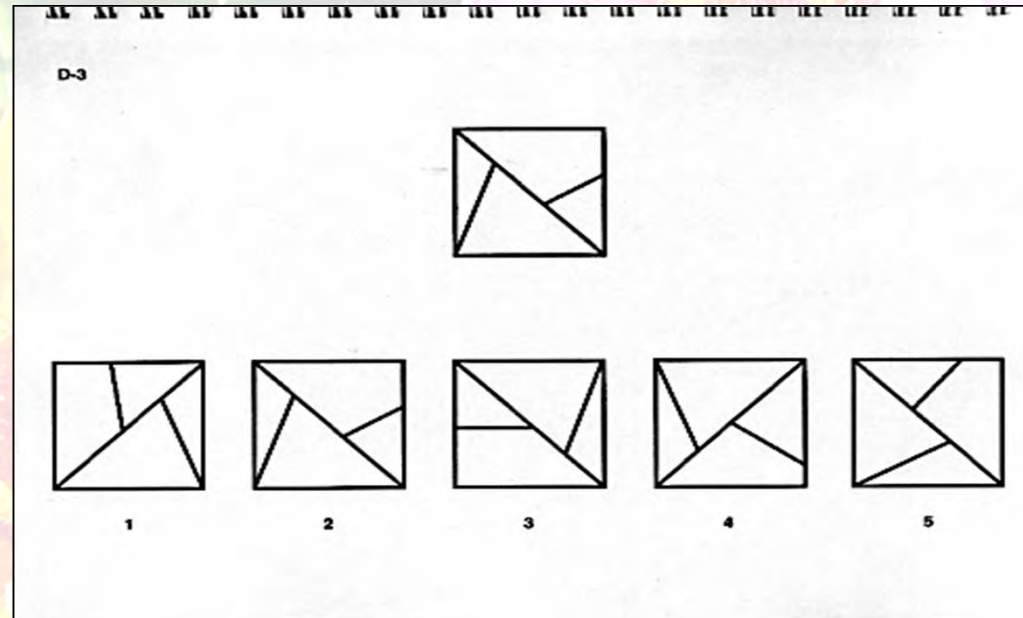
12 Basic Processes are:

1. Vision
2. Visual Motor Processing

3. **Visual
Discrimination**



Visual Discrimination



1. <http://www.ncld.org/ld-basics/related-issues/information-processing/visual-processing-disorders>
2. <http://yourtherapysource.com/whatsmissing.html>(picture source)
3. http://www.umsl.edu/~garziar/TVPS_table.htm

12 Basic Processes are:

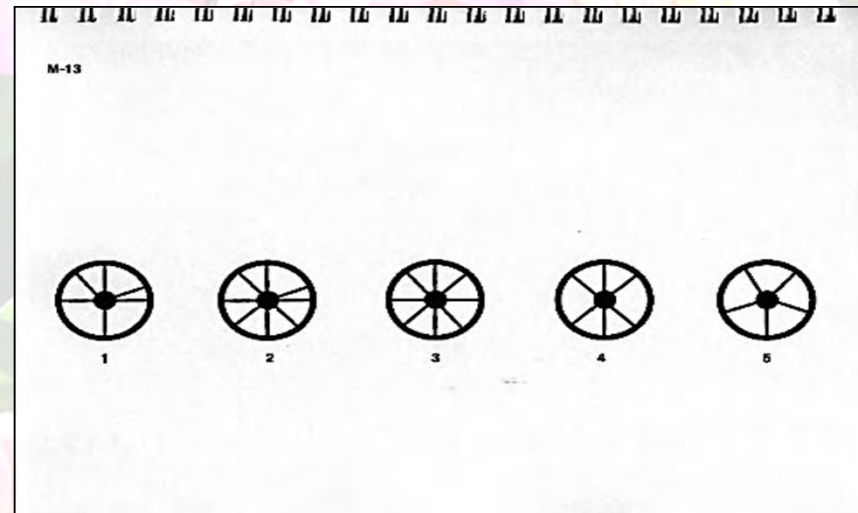
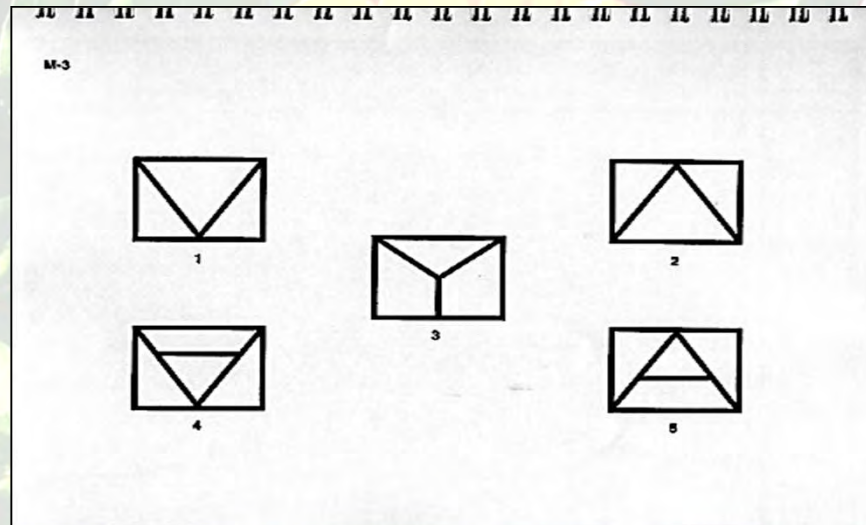
1. Vision
2. Visual Motor Processing
3. Visual Discrimination

4. ***Visual Memory***



Visual Memory

One item is presented for 5 seconds, then removed to reveal 5 choices which the participant has to then match. Visual memory requires that a stimulus be present in order to recall the information for future use whether it be 5 seconds, 5 hours or 5 days.



1. <http://www.ncld.org/ld-basics/related-issues/information-processing/visual-processing-disorders>
2. http://www.umsl.edu/~garziar/TVPS_table.htm

12 Basic Processes are:

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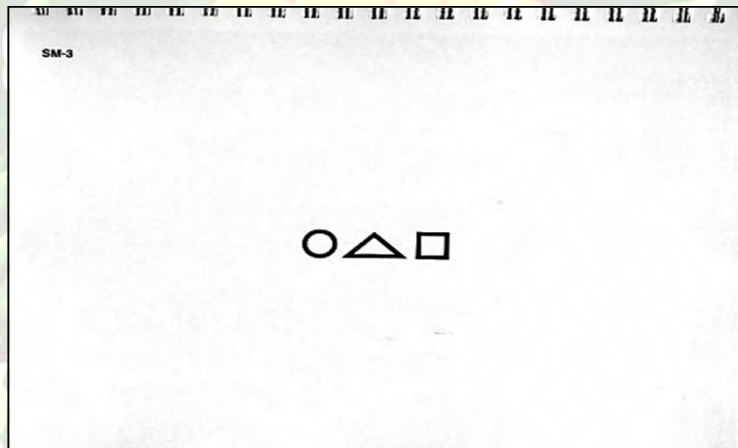
5. **Visual
Sequential
Memory**



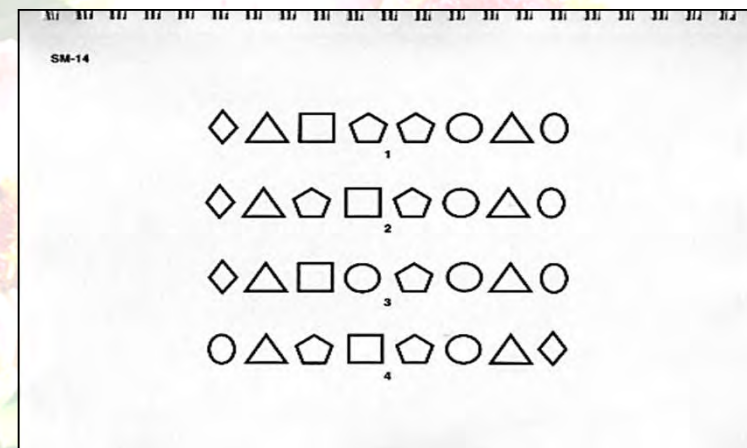
Visual Sequential Memory

Is the ability to recall a sequence of numbers, shapes or letters.

Easy



Hard



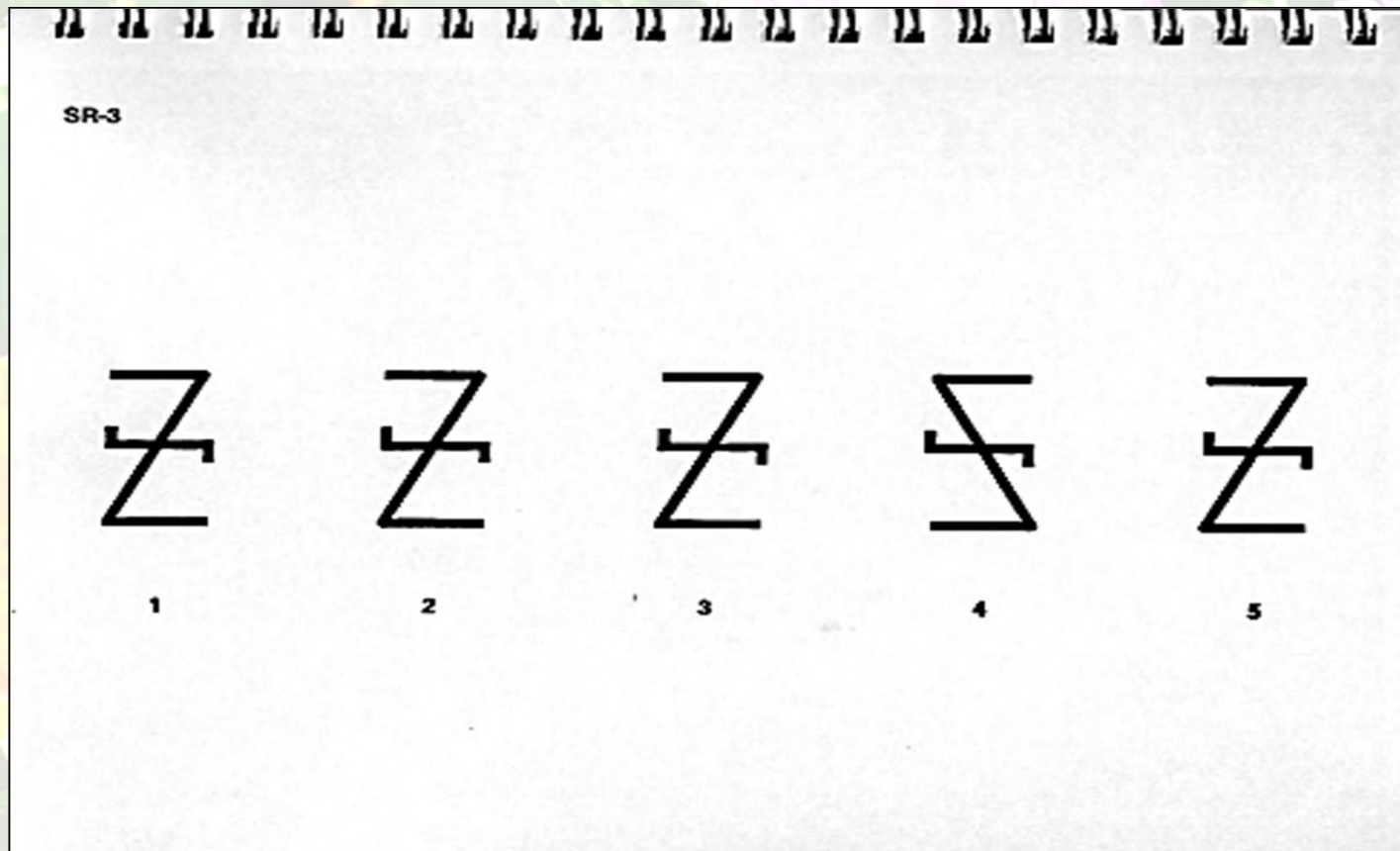
12 Basic Processes are:

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6. **Visual
Spatial
Processing**



Visual Spatial Processing



12 Basic Processes are:

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6. Visual Spatial Processing

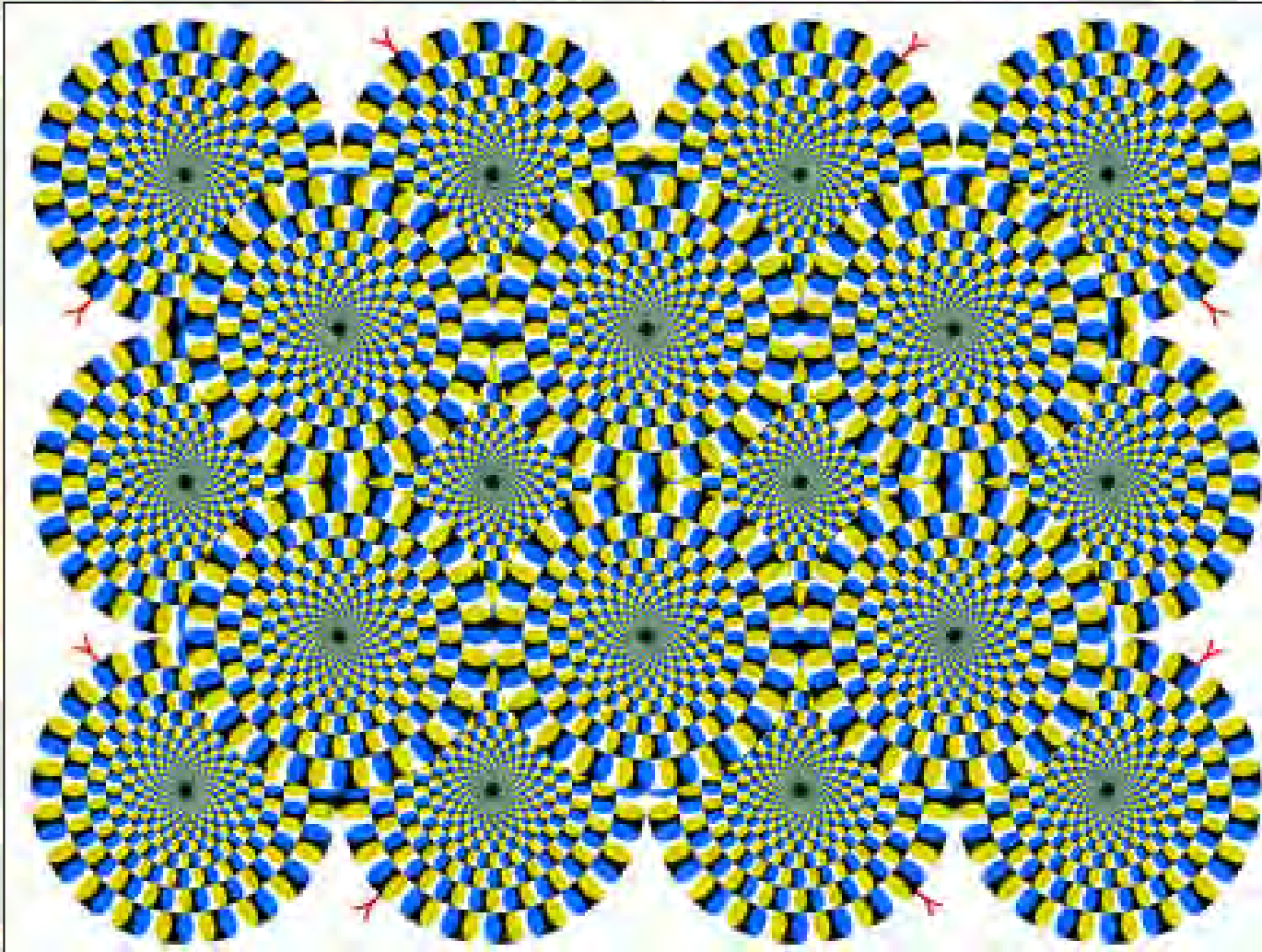
7. **Visual Figure Ground**



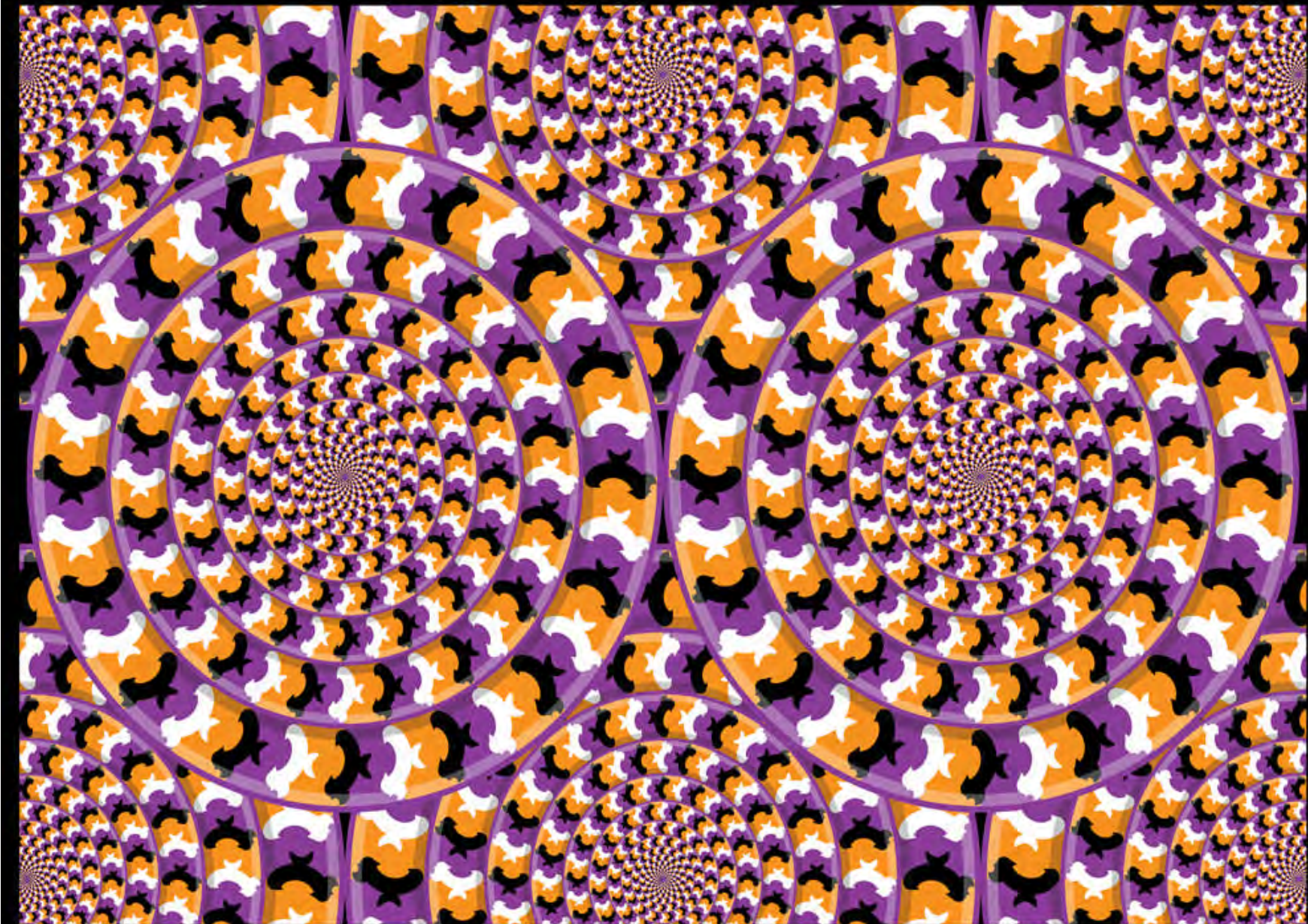
A good example of Visual Figure Ground would be to pick out an animal from the picture without distraction. Whilst being able to describe the animal of choice without losing focus, orientation or description of the object.



Visual Figure Ground



1. <http://www.ncld.org/ld-basics/related-issues/information-processing/visual-processing-disorders>
2. <http://ha065.wordpress.com/gamswen/perception-and-illusion/>
3. <http://www.myspace.com/jpnemonia/photos/14901045>



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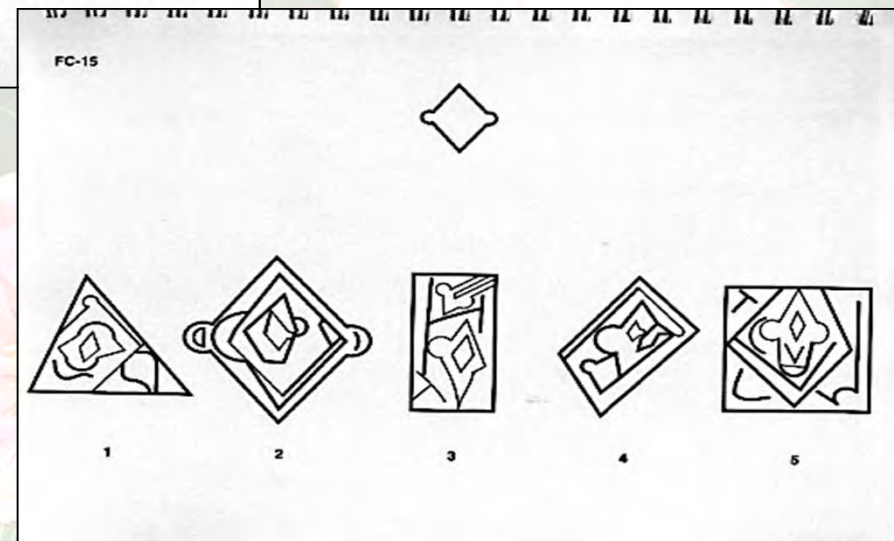
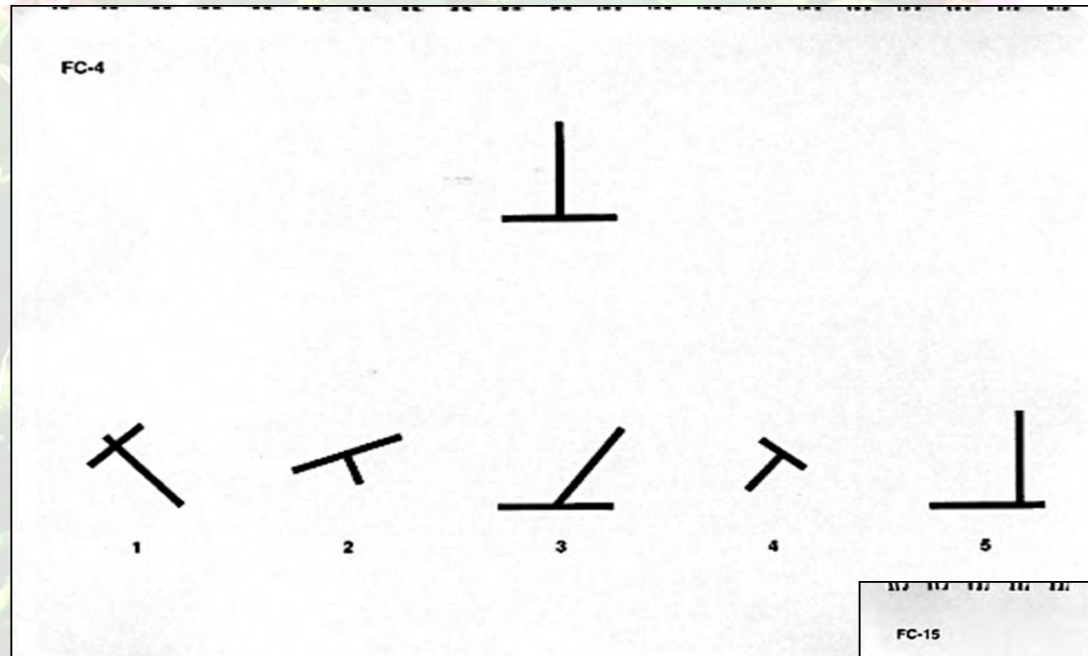
8. **Visual**

Form

Constancy



Visual Form Constancy



1. <http://drzachryspedsottips.blogspot.com/2011/05/visual-form-constancy.html>
2. http://www.umsl.edu/~garziar/TVPS_table.htm

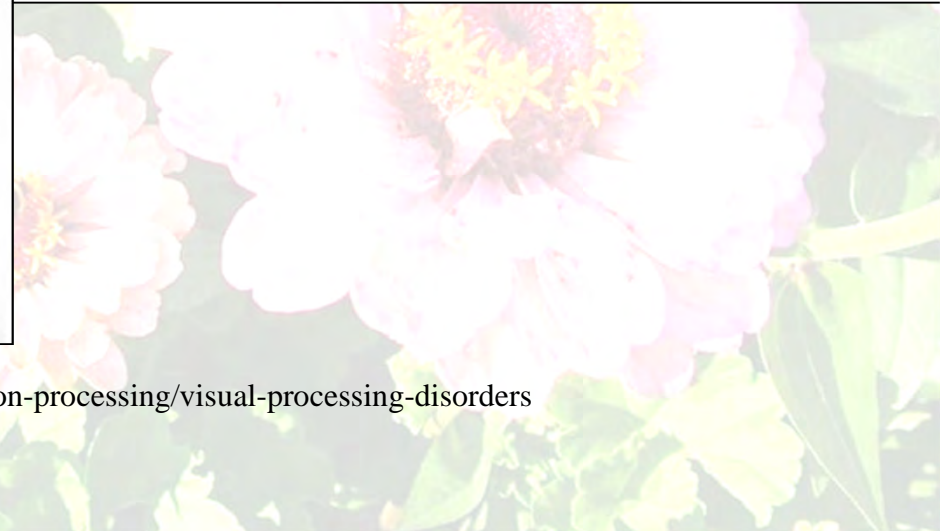
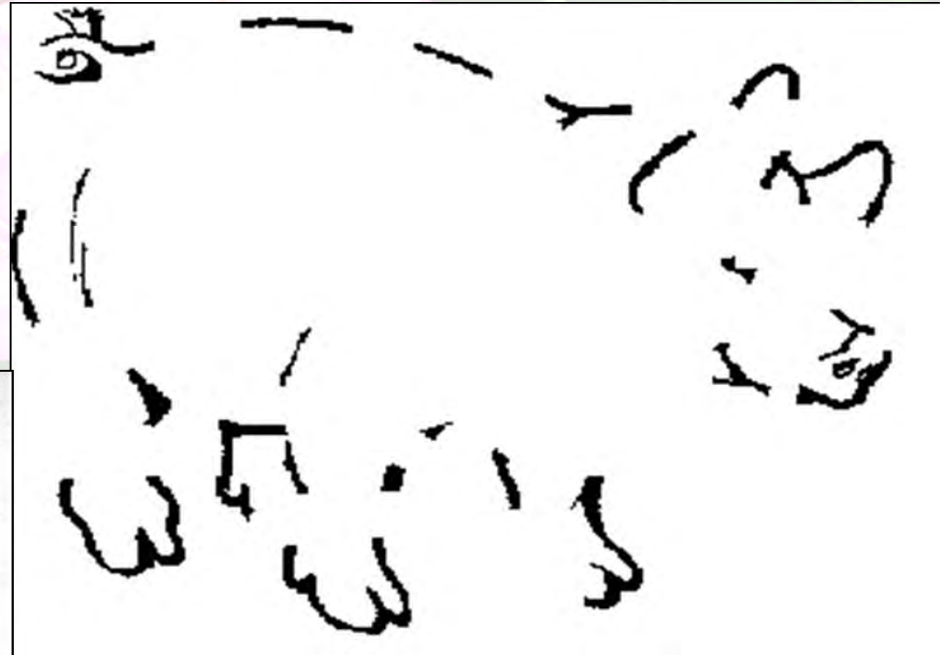
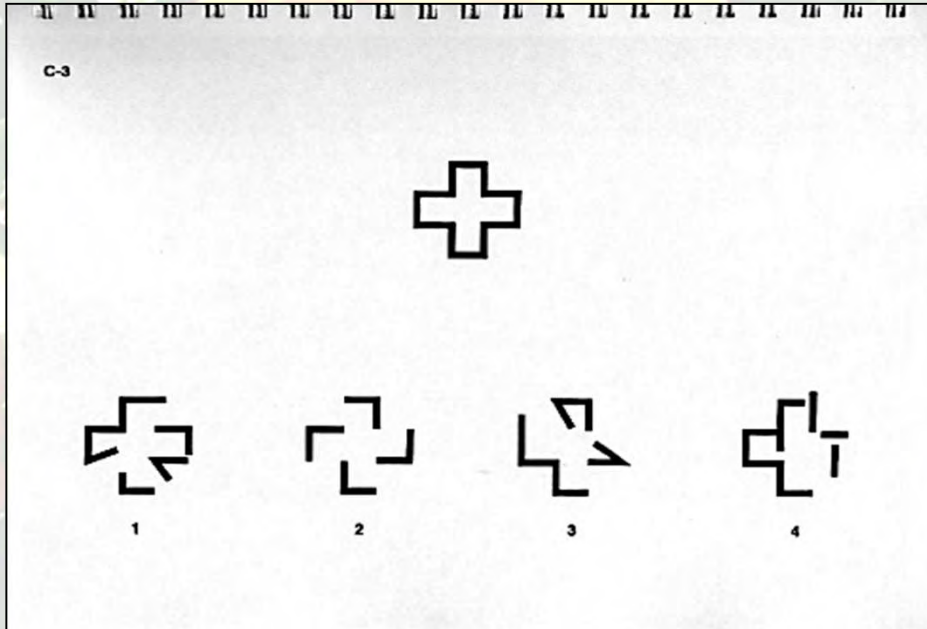
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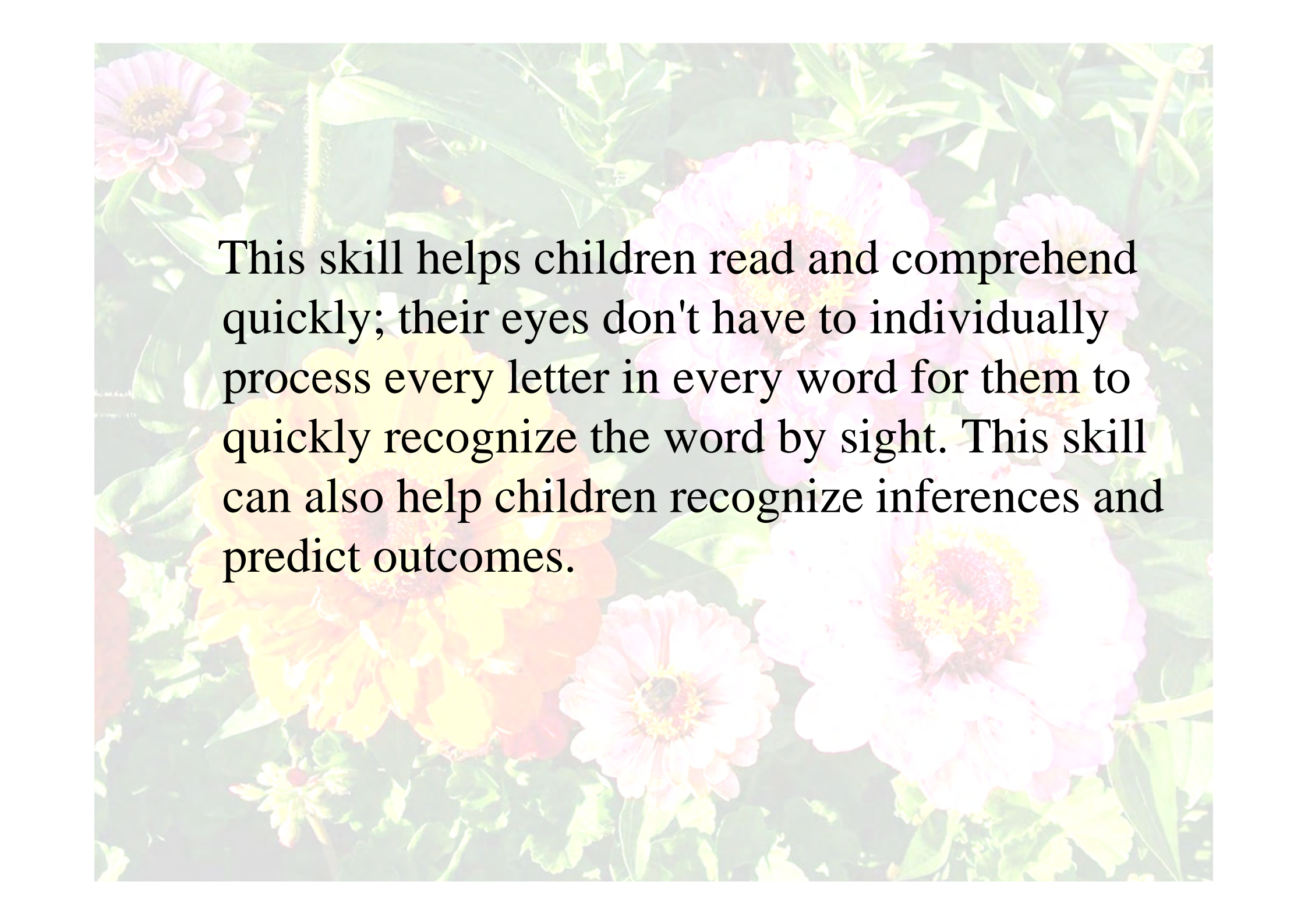
9. **Visual
Closure**



Visual Closure



1. <http://www.ncl.org/ld-basics/related-issues/information-processing/visual-processing-disorders>
2. <http://www.eyecanlearn.com/closure.htm>
3. http://www.umsl.edu/~garziar/TVPS_table.htm



This skill helps children read and comprehend quickly; their eyes don't have to individually process every letter in every word for them to quickly recognize the word by sight. This skill can also help children recognize inferences and predict outcomes.

12 Basic Processes are:

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7. Visual Figure Ground
8. Visual Form Constancy
9. Visual Closure

10 ***Binocularity***





Binocularity

“The ability to use both eyes as a "team.”

1. http://www.hopecliniconline.com/reading_learning_hope_clinic.php

Why is Binocularity Important?



The ability of both eyes to capture images, send them to the brain, and for the brain to "see" the final image. The two eyes working together as a coordinated team is called binocular vision (binocularity), and it is responsible for much of our depth perception, an extremely important aspect of vision.

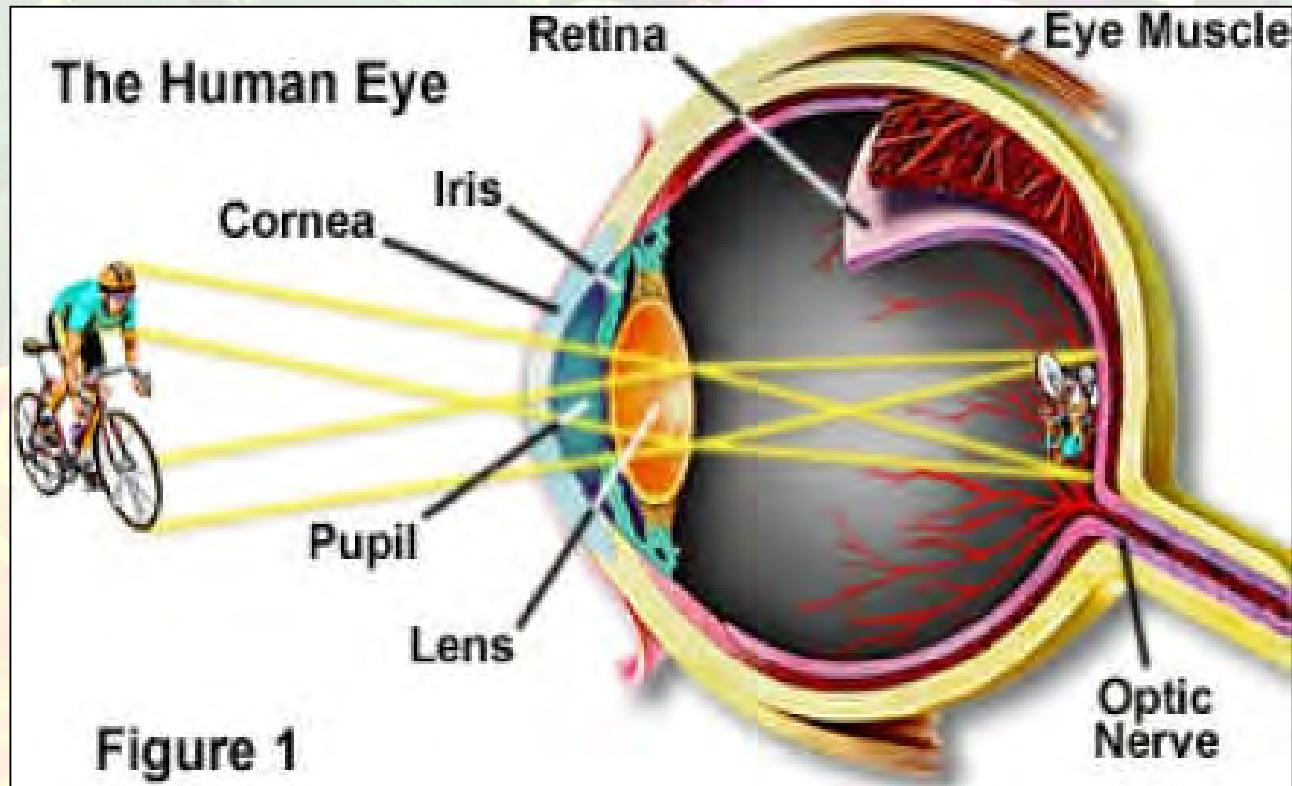
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10. Binocularity

11. **Visual**
Accommodation



Visual Accommodation



“Accommodation occurs by stimulating the smooth muscle of the ciliary body in the eye to contract, thereby enabling the lens to change its shape”³

1. <http://medical-dictionary.thefreedictionary.com/visual+accommodation>
2. <http://www.ssc.education.ed.ac.uk/courses/pictures/vmay082.jpg>
3. Understanding and Managing Vision Deficits, A Guide for Occupational Therapist;2nd Ed., Mitchell Scheiman, Slack Inc.

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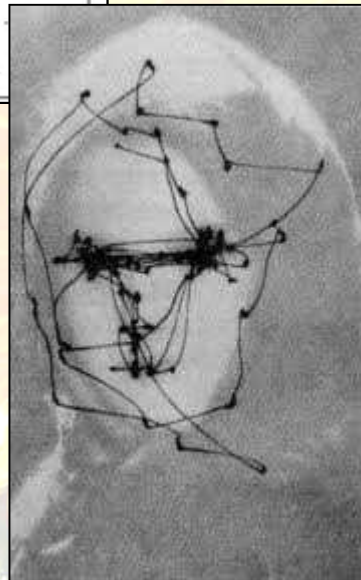
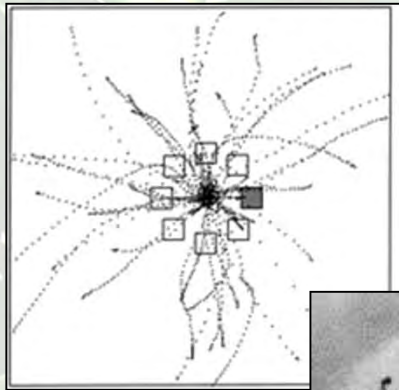
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11. Visual Accommodation

12 *Visual Saccades*



Visual Saccades are:

The series of involuntary, abrupt, rapid, small movements or jerks of both eyes simultaneously in changing the point of fixation. ^{3,4}



DANS, KÖN OCH JAGPROJEKT

På jakt efter ungdomars kroppsspråk och den symboliska dansen: en sammansättning av olika kulturers dans har jag i ett fallarbete under hösten 2017 gått på olika arenor inom skolans värld. Nordiska, afrikanska, syd- och osteuropiska ungdomar ger sina rötter, böda, genon, sång, musik, skrik, skrift och gestaltade konstler och uttryck med hjälp av kroppsspråk och dans.

Den individuella estetiken framträder i kläder, frisyrer och symboliska tecken som förstärker ungdomarnas "jagprojekt" där också den egna stilen i kroppshållningen spelar en betydande roll i identitetsprovningen. Upphållsrummet fungerar som ett uttryck där ungdomarna spelar upp sina performansrelaterade kroppsspråk

1. ^ a b Cassin, B. and Solomon, S. *Dictionary of Eye Terminology*. Gainesville, Florida: Triad Publishing Company, 1990[[page needed](#)]
2. The American Heritage® Medical Dictionary Copyright © 2007, 2004 by Houghton Mifflin Company. Published by Houghton Mifflin Company
3. Dorland's Medical Dictionary for Health Consumers. © 2007 by Saunders, an imprint of Elsevier, Inc. All rights reserved.
4. Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing, and Allied Health, Seventh Edition. © 2003 by Saunders, an imprint of Elsevier, Inc. All rights reserved.

Role of OT and Visual Processing

- Identify unmet needs in our communities and address the need, as deemed appropriate according to our state practice act.
- Receive the adequate training necessary to treat the patients needs.
- Create a plan of action
- Act on the POC by means of strengthening through exercise, education, home plans or modification/ adaptations to the areas of weakness, causing dysfunction in ADL, physiological, work , play, leisure and learning.

The State of Florida Practice Act states: (section is paraphrased for space)

Chapter 468 Part 111 Occupational Therapy:

1. Achieving Functional Outcomes it describes who we may see by definition.
2. Assessment by means of skilled observation or the administration and interpretation of standardized or non-standardized tests and measurements
 2. Interventions directed toward developing daily living skills, work readiness or work performance, play skills or leisure capacities, or enhancing educational performance skills.

PLEASE SEE

<http://www.leg.state.fl.us/statutes>

What is Motor Processing?

- The ability to plan and execute skilled non-habitual tasks. Also called motor praxis.² Motor processing has also been referred to as Temporal processing.
- Praxis is possible through a three-step process:
 - Ideation (understanding the task)
 - Organization (planning how to perform the task) and
 - Execution (carrying out the task).³
- Exercises can be customized and involve a hierarchy of increasingly complex and precisely timed motor movements intertwined with gradually higher & faster cognitive processing, attention and decision-making.¹

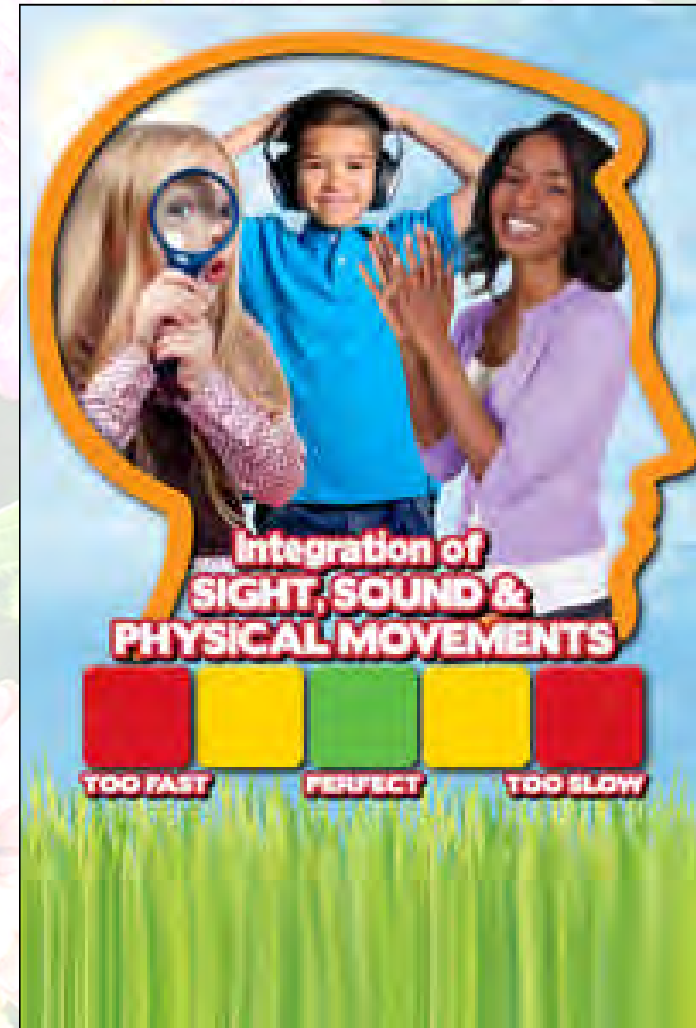
1. <https://www.interactivemetronome.com/index.php/what-is-imhome/how-it-works.html>

2. Mosby's Medical Dictionary, 8th edition. © 2009, Elsevier.

3. http://www.listenandlearn.com.au/disorders_dyspraxia.asp

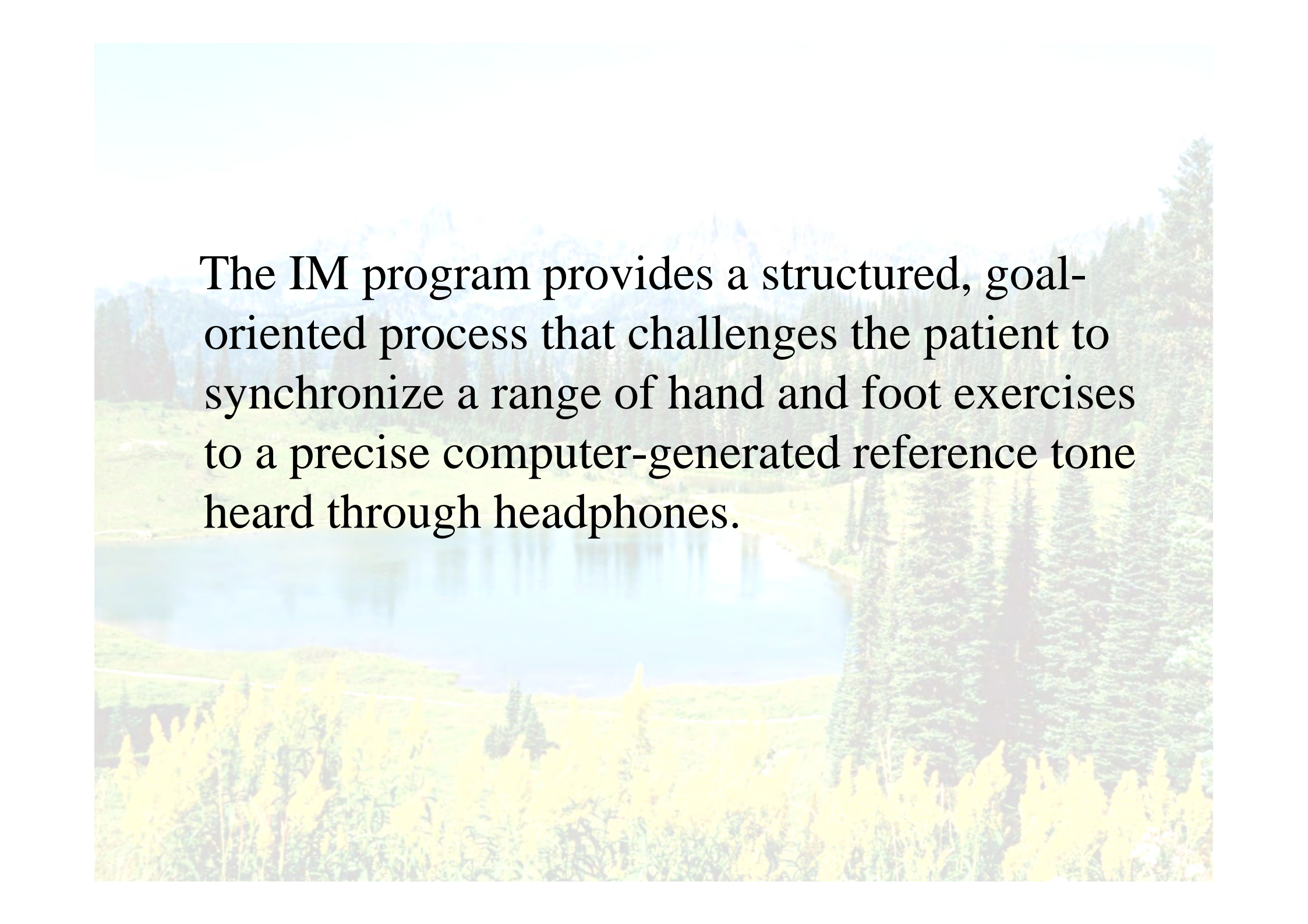
What is Interactive Metronome?

The Interactive Metronome (IM) is a research-based training program that helps children and adults overcome attention, memory, and coordination limitations. IM works for people of all ages who have a variety of conditions affecting their cognitive and physical abilities.





(IM) is an assessment and treatment tool used in therapy to improve the neurological processes of motor planning, sequencing and processing.

A scenic landscape featuring a calm lake in the middle ground, surrounded by lush green hills and dense evergreen forests. In the foreground, there are vibrant yellow wildflowers. The background shows misty mountains under a soft, overcast sky. The overall atmosphere is peaceful and natural.

The IM program provides a structured, goal-oriented process that challenges the patient to synchronize a range of hand and foot exercises to a precise computer-generated reference tone heard through headphones.



Over the course of the treatment, patients learn to:

- Focus and attend
- Increase physical endurance
- Filter out internal and external distractions
- Improve ability to concentrate
- Progressively improve coordinated motor skills performance.

Treatment Diagnosis may include but are NOT limited to the following:

- Sensory Integration Disorder
- ADD/ADHD
- Traumatic Brain Injury (TBI)
- Cerebral Vascular Accident (CVA)
- Autism Spectrum Disorder (ASD)
- Cerebral Palsy (CP)
- Non-verbal Learning Disorder (NVLD)
- Balance Disorders
- Limb Amputation
- Parkinson's Disease
- Multiple Sclerosis (MS)

Temporal Processing affects the following

ADHD

Attention

Auditory Processing

Autism

Brain Injury

Dyslexia

Executive Functions

Intelligence

Memory/ Working Memory

Mental Timing Theory

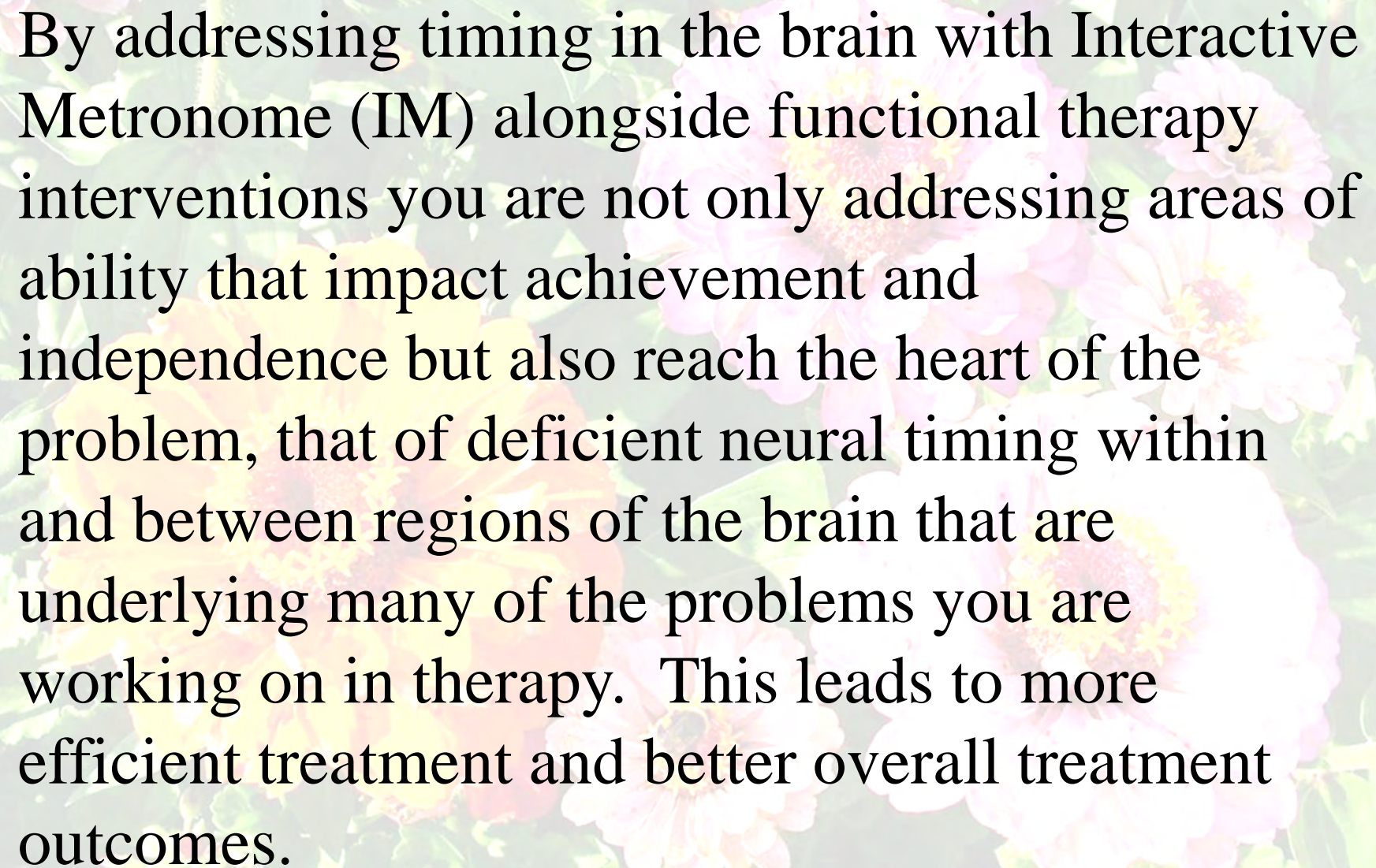
Motor Skills

Music

Processing Speed

Reading

Speech



By addressing timing in the brain with Interactive Metronome (IM) alongside functional therapy interventions you are not only addressing areas of ability that impact achievement and independence but also reach the heart of the problem, that of deficient neural timing within and between regions of the brain that are underlying many of the problems you are working on in therapy. This leads to more efficient treatment and better overall treatment outcomes.

Insert video of Interactive Metronome here



Role of OT with Visual Motor Skills

As Occupational Therapist we have a responsibility to provide training essential to integrate the systems of visual and motor processing so individuals can make gains in all aspects of learning across the educational, work and leisure spectrum. The visual system is one of the most valuable ways of gathering information for learning new processes.



2 Case Studies

Utilizing Visual Processing and Motor Processing Tools



Interactive Metronome

#1

Case Study Review



Early Intervention For Non-Verbal Learning Disorder With IM

Layla is 19 months of age with Non-Verbal Learning Disorder, and other medical conditions including Microcephaly. From early stages she was unable to walk unsupported, no utterances were heard from her, and she only had 3-5 simple signs for communication with her parents. Layla's attention was fleeting, with less than 2 seconds devoted to any given task.

At first, Layla's parents and doctors tried occupational therapy. As the weeks in therapy progressed she made great strides with her standing and walked with a pediatric walker, yet she was still not paying attention or uttering sounds. To improve her attention and her communication skills, they decided to try Layla on Interactive Metronome (IM).

The IM program provides a structured, goal-oriented process that challenges the patient to synchronize a range of hand and foot exercises to a precise computer-generated reference tone heard through headphones. The patient attempts to match the rhythmic beat with repetitive motor actions. A patented auditory-visual guidance system provides immediate feedback measured in milliseconds, and a score is provided. IM is a research-backed treatment program that helps improve timing through exercise and practice.

Due to her age and attention, Layla started IM sessions, assisted by her therapist, with 2 exercises and increased to 3 exercises by session 6 (of 15). Layla was very sensitive to the sound of the IM and the tactile stimulation of wearing the headphones, so soft preemie headbands and small pediatric headphones were used to minimize her discomfort.

Initially, halfway through the session, Layla would seek out a pacifier, her soothing device for anxiety, but soon began to refrain from seeking her pacifier. After 3-4 sessions, Layla would pick up the cards presented to her and intently examine the ones she was intrigued with; as the session progressed, so did her interest in the details the cards offered her. She was asked to point out specific details in some of the cards, and she could - with an amazing accuracy of approximately 90%. Layla also began to exhibit excitement, mimicking the movements of the IM and signing the word "play".

Layla has begun using sign language in 2-3 word combinations to increase her ability in being understood and expressing herself. She is using her eyes to track objects in her immediate environment, and she has begun to develop fine motor manipulative skills to further aid her in proper motor skills development.

Layla's mother reports that her utterances have increased drastically and now she makes sounds such as "ba," "da," "ma" and "pa," which are all clear indications of speech babble prior to beginning purposeful speaking. It's music to her mother's ears!

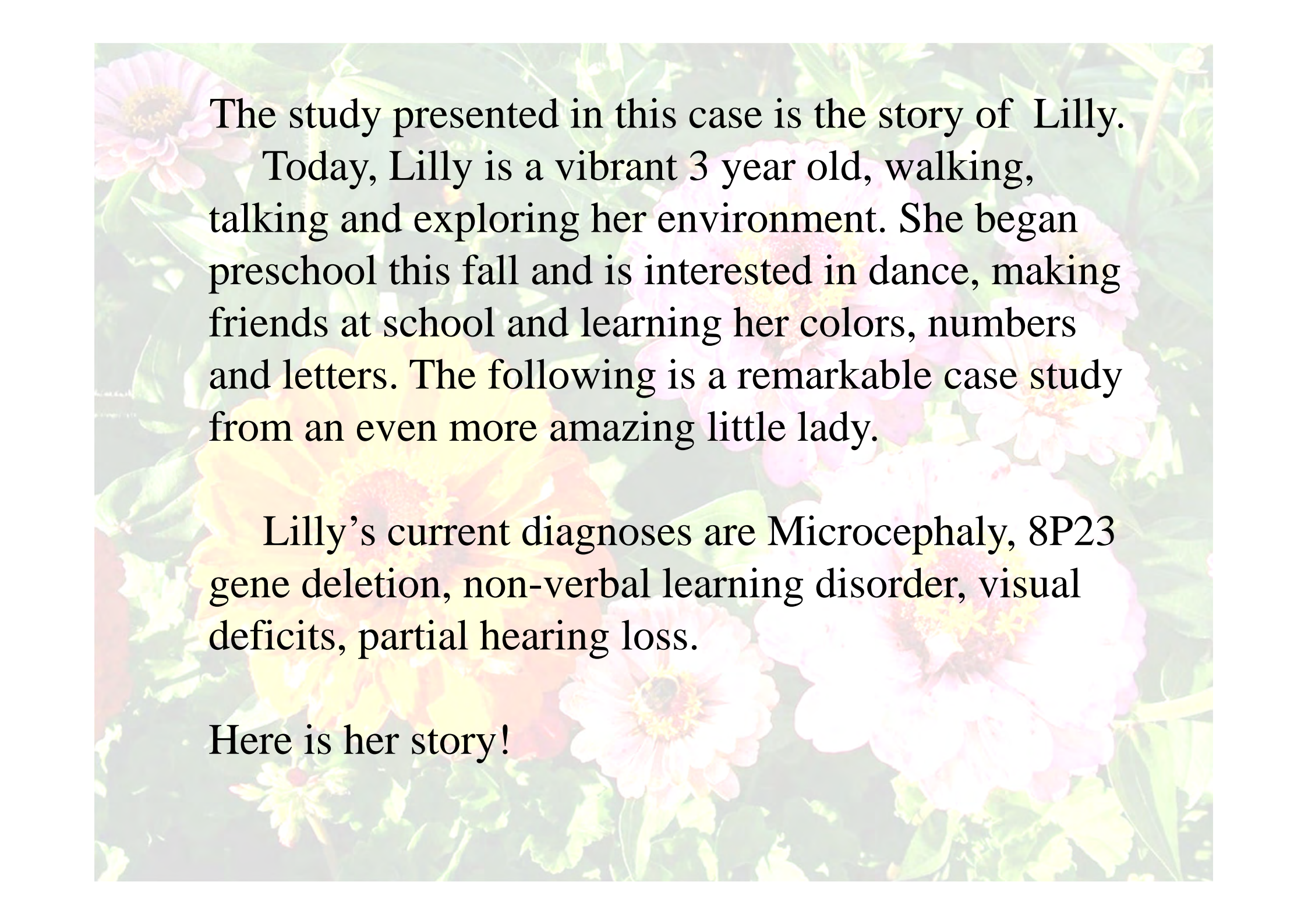
Beth A. Kelley, OT/RI

Brisaki Rehabilitation Clinic - Mandarin Occupational Clinic
Jacksonville, FL

www.InteractiveMetronome.com • 877-994-6776



IM can now be done at home! www.IMHome.org



The study presented in this case is the story of Lilly. Today, Lilly is a vibrant 3 year old, walking, talking and exploring her environment. She began preschool this fall and is interested in dance, making friends at school and learning her colors, numbers and letters. The following is a remarkable case study from an even more amazing little lady.

Lilly's current diagnoses are Microcephaly, 8P23 gene deletion, non-verbal learning disorder, visual deficits, partial hearing loss.

Here is her story!



Early reflexes not integrated,
extension dominant

Lilly here at 4-6 months

Lilly had difficulty motor planning her movements she could not figure out how to move her upper body or her lower body in sequence such as rolling or coming to sit unassisted.





Lilly here at approx. 4 months, again with fisted hands and full body extension.

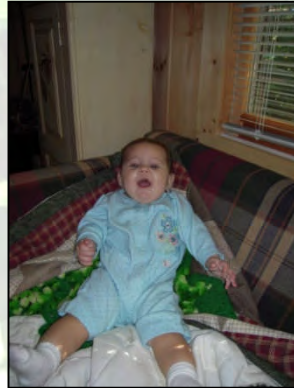
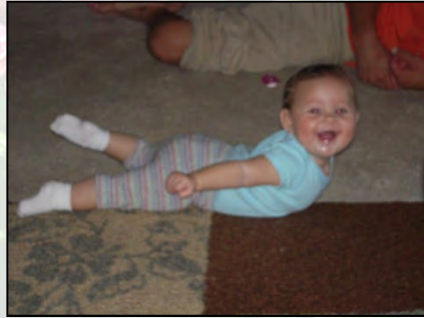
Lilly at 6-8 months

Fisting hands. Hips, knees feet / toes in extension.



Fisting hands, back and LE's in extension





Developmentally we see that Lilly has difficulty with a few things listed:

1. Coordinating her upper body with the lower body
2. She could not segment her movements such as coming in quadruped position on hands and knees. Breaking the extension patterns were difficult for her.
3. She had little to no hip flexion or rotation of the pelvis.
4. Poor trunk control
5. Poor sitting balance
6. Poor response time to auditory stimulation
7. Poor visual/ motor tracking skills
8. Her head position was always in one plane of movement, never with any head rotation.
9. Hands remained fist
10. Poor prehensile pincher grip or grasp, picking up cheerios was difficult with her fingers in isolation.

Lilly at 9 months beginning therapy



VIDEO



Notice Lilly's wide base of support and arms abducted for balance, now we start to see her reaching and eye contact begin to impact her play.

Lilly here is bringing her hands together in midline, she loves music and dancing!



Lilly beginning multi-disciplines PT/ OT/ ST



VIDEO



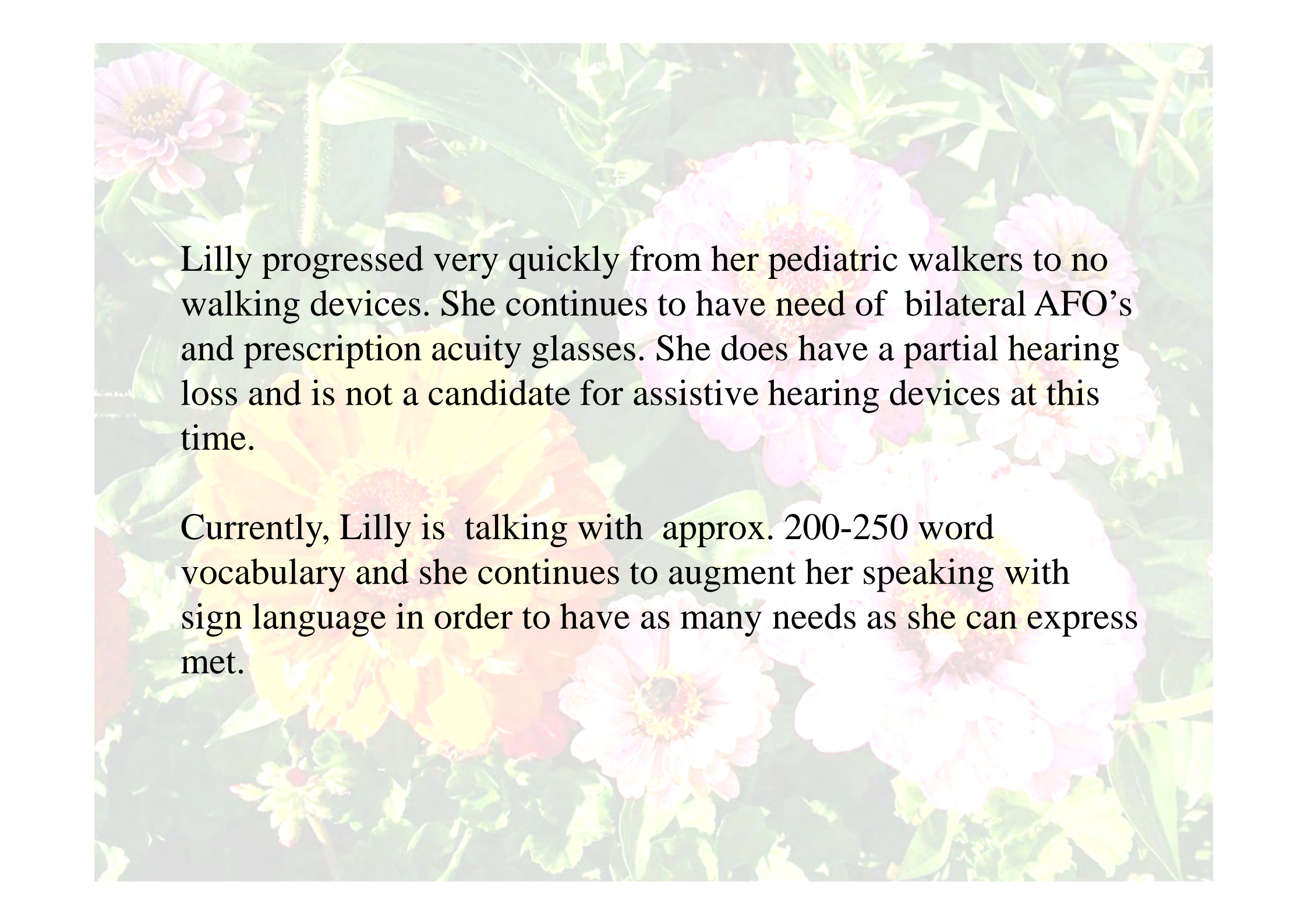
The start of MOTOR PROCESSING THERAPY PROTOCOLS:

What you do not see :

1. Right hand in isolation listening through pedi head phones
2. Left hand in isolation
3. Both hands together (rhyming, songs, ABC, counting to 10, etc.)
4. Both feet moved to a beat while mother read a book to her or played with themed sets of manipulatives.



Lilly gains more independence with her rolling walker



Lilly progressed very quickly from her pediatric walkers to no walking devices. She continues to have need of bilateral AFO's and prescription acuity glasses. She does have a partial hearing loss and is not a candidate for assistive hearing devices at this time.

Currently, Lilly is talking with approx. 200-250 word vocabulary and she continues to augment her speaking with sign language in order to have as many needs as she can express met.

Current pictures of Lilly



A scenic landscape featuring a calm lake in the middle ground, surrounded by lush green hills and a dense forest of tall evergreen trees. In the background, majestic mountains rise under a clear sky. The foreground is filled with vibrant yellow wildflowers. The overall scene is peaceful and natural.

Interactive Metronome

#2

**Case Study
Review**

The effects of OCD, Tourette's Syndrome, ADD and PANDAS with Interactive Metronome



A scenic landscape featuring a calm lake in the foreground, surrounded by lush green fields and dense evergreen forests. In the background, majestic mountains rise under a clear sky. The overall scene is peaceful and natural.

BJ a 15 year old teenager has been diagnosed with ADD, SLD, PANDAS, OCD and Tourette's Syndrome.

BJ's individual test scores:

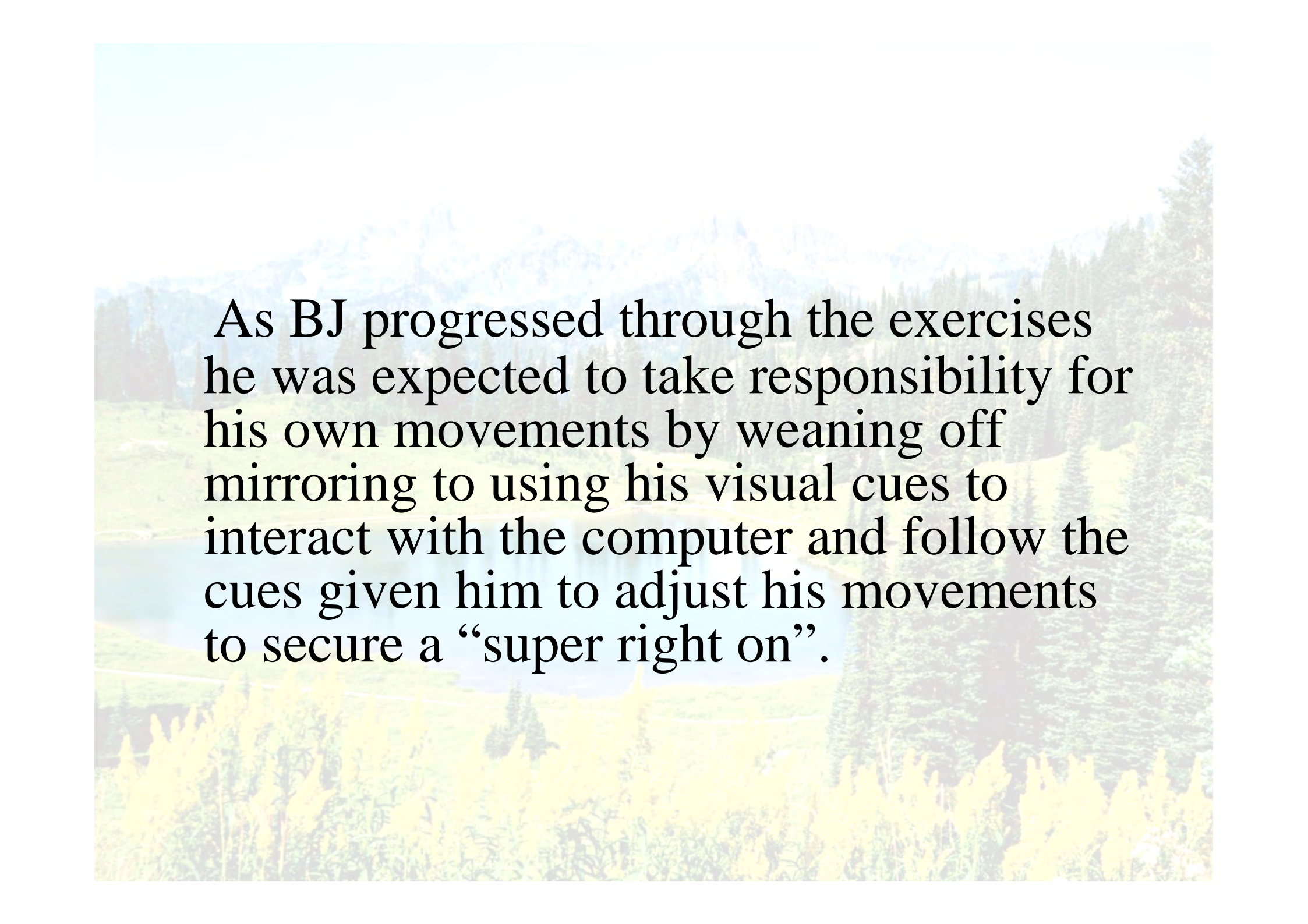
Initial test averages: AHA: 144.05 ms AFA: 132.77 ms ALFTA: 138.41 ms

Interim test averages: AHA: 19.65 ms AFA: 32.23 ms ALFTA: 25.94 ms

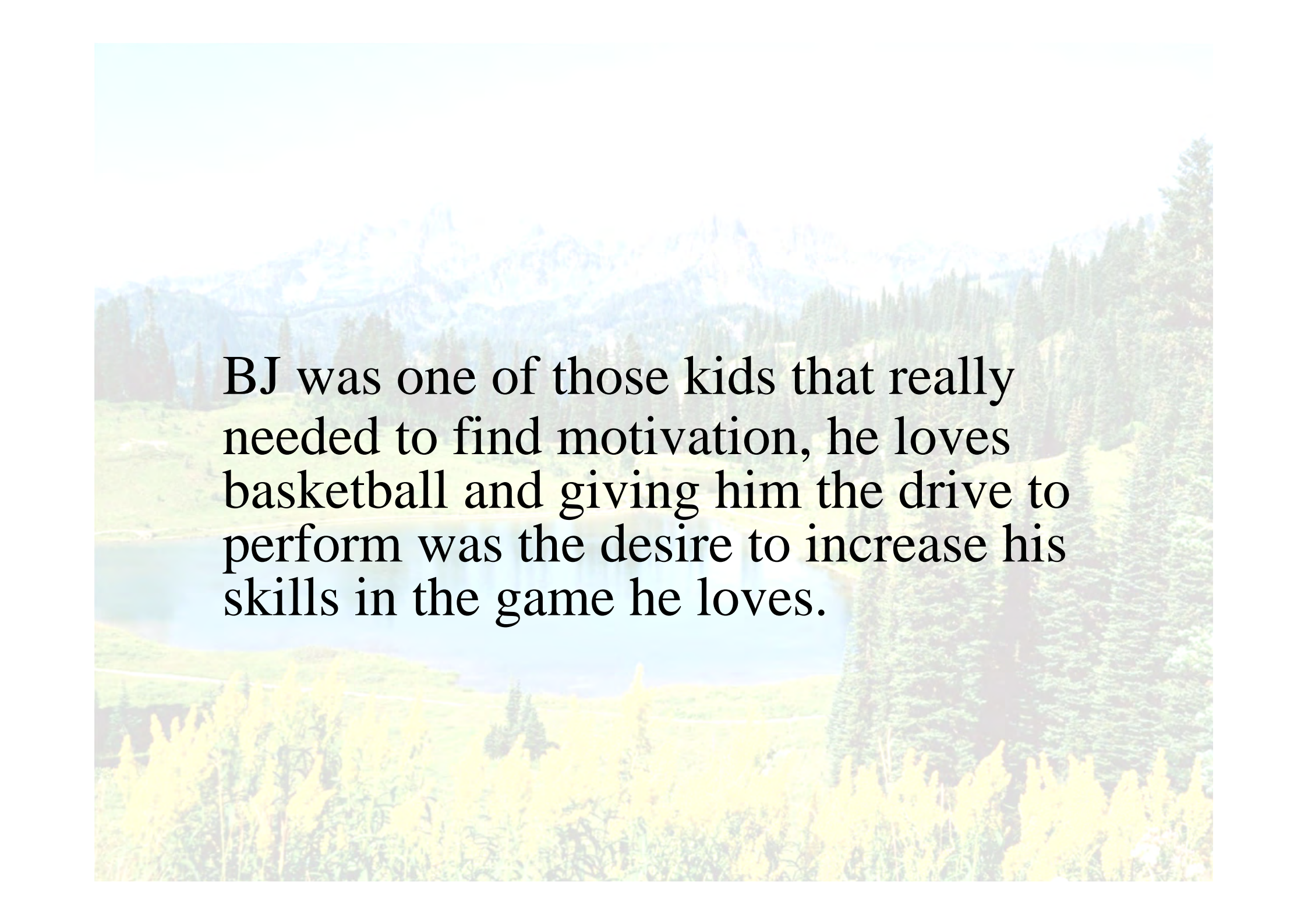
METHODOLOGY:

The first 5 exercises were set up facing the clinician for visual guidance using a mirroring technique.

Once these skills were mastered with scores below 29 ms with 3 consecutive treatment sessions then the remaining exercises 6-13 could systematically be added to the treatment with a clinically significant higher degree of success.

A scenic landscape featuring a calm lake in the foreground, surrounded by lush green hills and a dense forest of evergreen trees. In the background, majestic mountains rise under a clear sky. The overall scene is peaceful and natural.

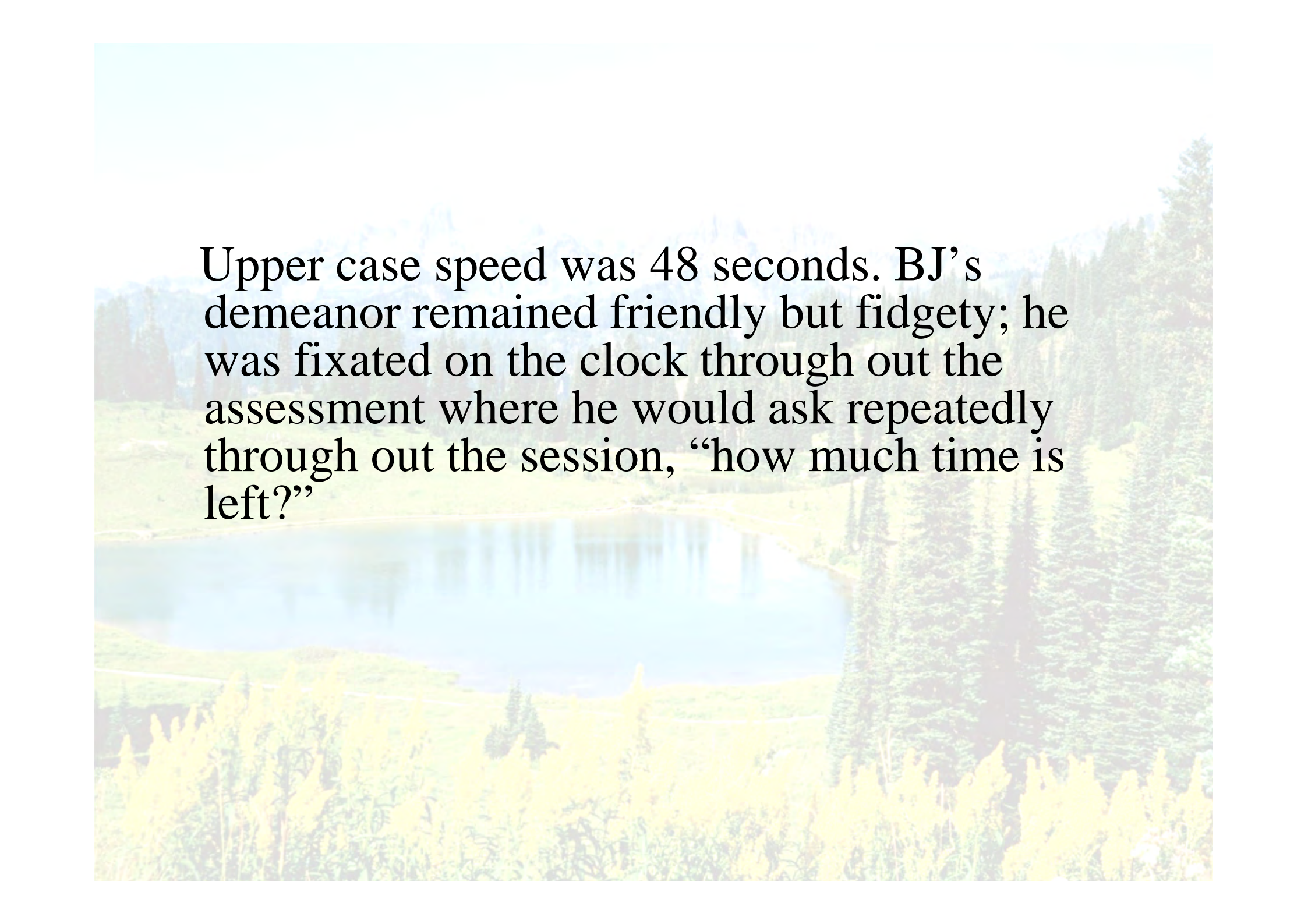
As BJ progressed through the exercises he was expected to take responsibility for his own movements by weaning off mirroring to using his visual cues to interact with the computer and follow the cues given him to adjust his movements to secure a “super right on”.

A scenic landscape featuring a calm lake in the foreground, surrounded by lush green hills and a dense forest of evergreen trees. In the background, majestic mountains with patches of snow rise against a clear sky. The overall atmosphere is peaceful and natural.

BJ was one of those kids that really needed to find motivation, he loves basketball and giving him the drive to perform was the desire to increase his skills in the game he loves.

PRETESTS:

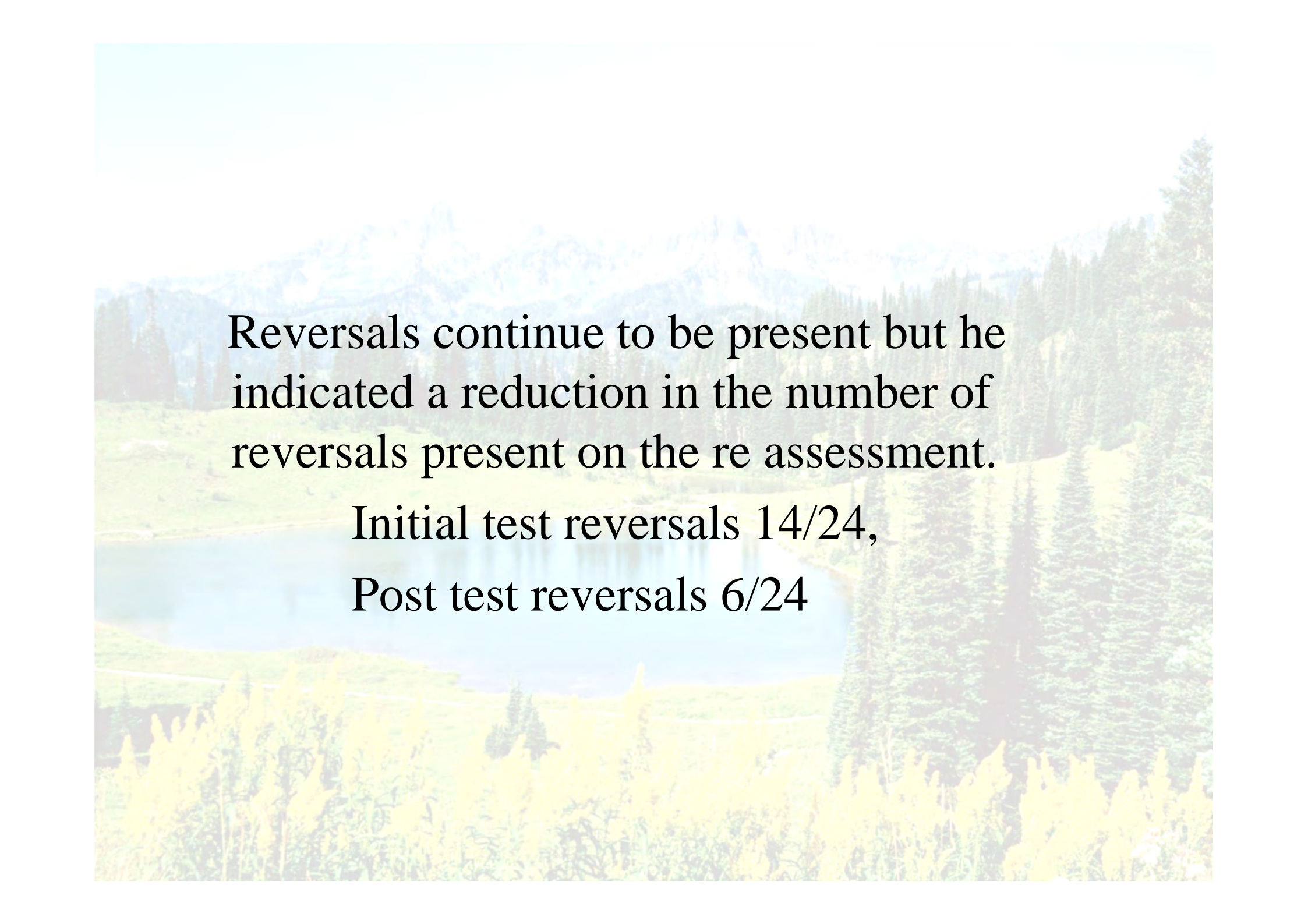
- (DEM)-Developmental Eye Movement Test
 - Results in abnormal range
- (THS-R)- Test of Handwriting Skills –Revised
 - Results: Below average
 - Errors: well below average

A scenic landscape featuring a calm lake in the middle ground, reflecting the sky. In the background, there are rolling green hills and distant mountains under a clear blue sky. The foreground is filled with tall, yellow wildflowers. The overall scene is peaceful and natural.

Upper case speed was 48 seconds. BJ's demeanor remained friendly but fidgety; he was fixated on the clock through out the assessment where he would ask repeatedly through out the session, "how much time is left?"

POST TESTS:

- (DEM)-Developmental Eye Movement Test
 - Improved to average / borderline
- (THS-R)- Test of Handwriting Skills- Rev.
 - Improved to average performance

A scenic landscape featuring a calm lake in the middle ground, surrounded by lush green hills and vibrant yellow wildflowers in the foreground. In the background, there are dense evergreen forests and majestic, snow-capped mountains under a clear sky.

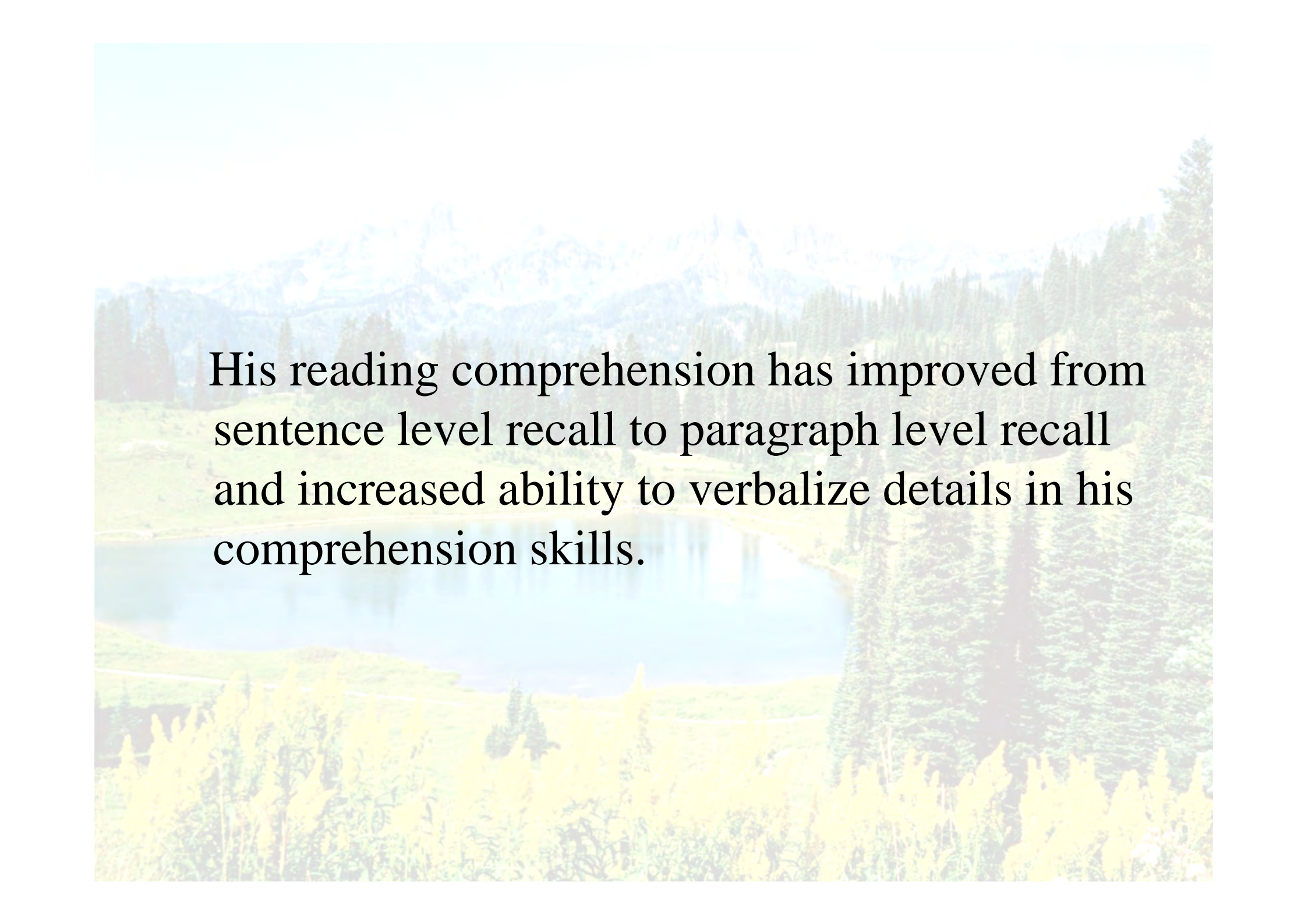
Reversals continue to be present but he indicated a reduction in the number of reversals present on the re assessment.

Initial test reversals 14/24,

Post test reversals 6/24

IMPRESSIONS:

BJ most noticeable improvement was his ability to concentrate on an activity with out asking questions during a designated activity. He has also improved with his need to fixate on the wall clock, instead of looking at the clock every 10-15 seconds he is now able to respond to verbal cues to stay on track while he is able to inhibit his need for glancing but 1-2 times every min. versus 1-2X every 10-15 seconds an estimated reduction by approximately 70%.

A scenic landscape featuring a calm lake in the middle ground, surrounded by dense evergreen forests. In the background, majestic mountains with patches of snow rise against a clear sky. The foreground is filled with tall, yellow wildflowers. The overall scene is peaceful and natural.

His reading comprehension has improved from sentence level recall to paragraph level recall and increased ability to verbalize details in his comprehension skills.

Final Results of Motor Processing

Post test averages: AHA: 19.66 ms AFA: 19.28 ms ALFTA: 19.47 ms

Improvements Noted: AHA: ↓124.39ms AFA: ↓ 113.49ms ALFTA:↓119.00 ms

Adjusted Hand Average (AHA) improved by 124.39 ms

Adjusted Foot Average (AHA) improved by 113.49 ms

Adjusted Long Form Test Average (ALFTA) improved by 119.00 ms

Other Research

1. Phyllis Weikart, a music and movement specialist as well as a researcher found that, "first graders who could walk to a steady beat scored better in reading, vocabulary and math in the California Achievement Test."

<http://www.internationalparentingassociation.org/Music/Kindermusic.html>

2. Sanes (2003) points out that whether a motor skill involves the adaptation of previously learned skills, or the formation of new sensory – motor relations, new patterns of neural activity are found. Learning a motor sequence yields convergent processing in the neo cortex from the frontal to the parietal regions as the skill becomes better learned. This indicates that the frontal cortex is involved in the acquisition of the motor skill whereas the knowledge about the sequence is primarily located in the parietal cortex

(see also Marois, 2002; Karni, Meyer, Jezzard, Adams, et al, 1995).

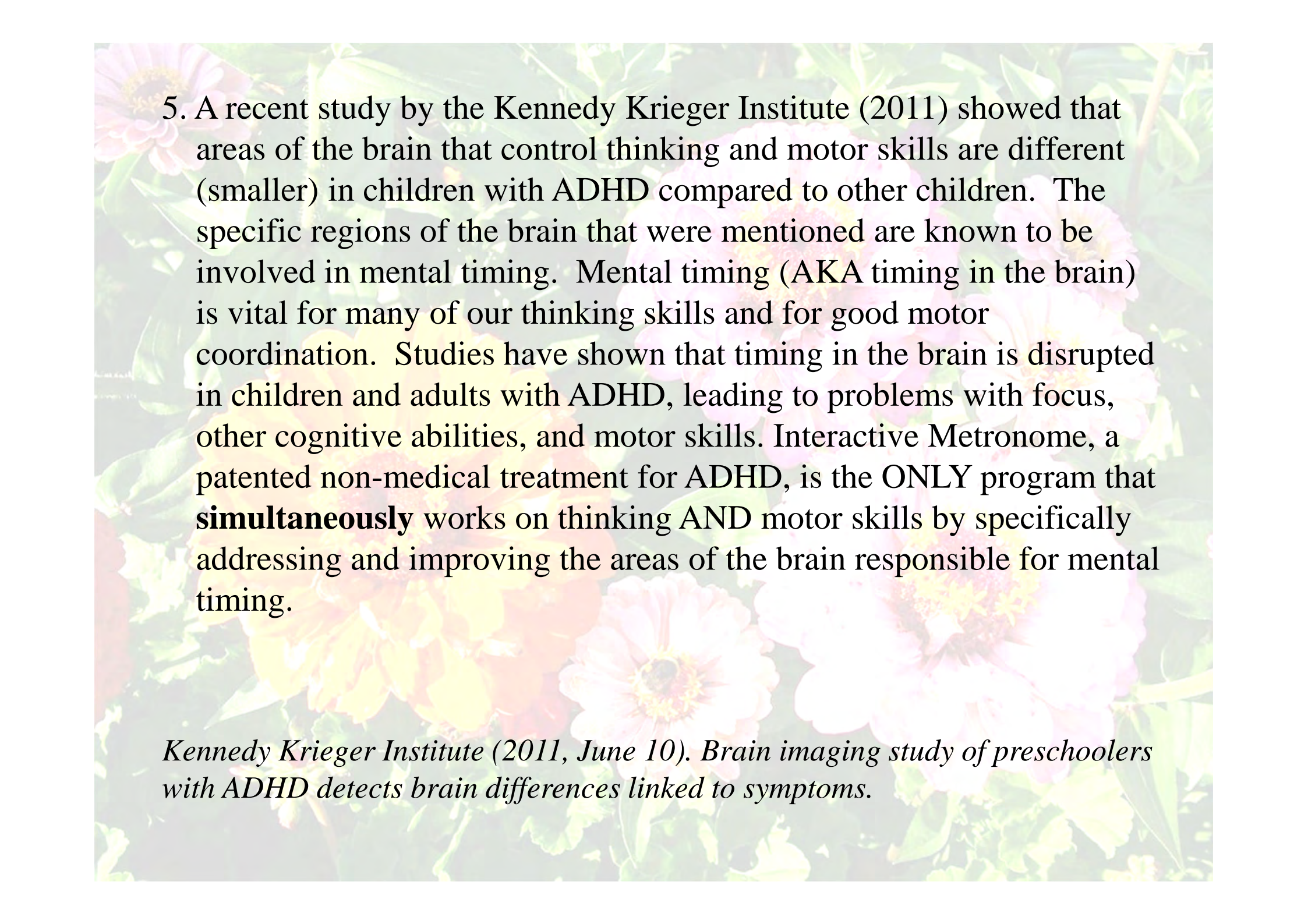
Research cont.

3. It requires a combination of attention, sensory integration and synchronization, and timing (Bhat & Sanes, 1998)

<http://www.interactivemetronome.com/IMW/IMPublic/Research/Dr.Gormman>

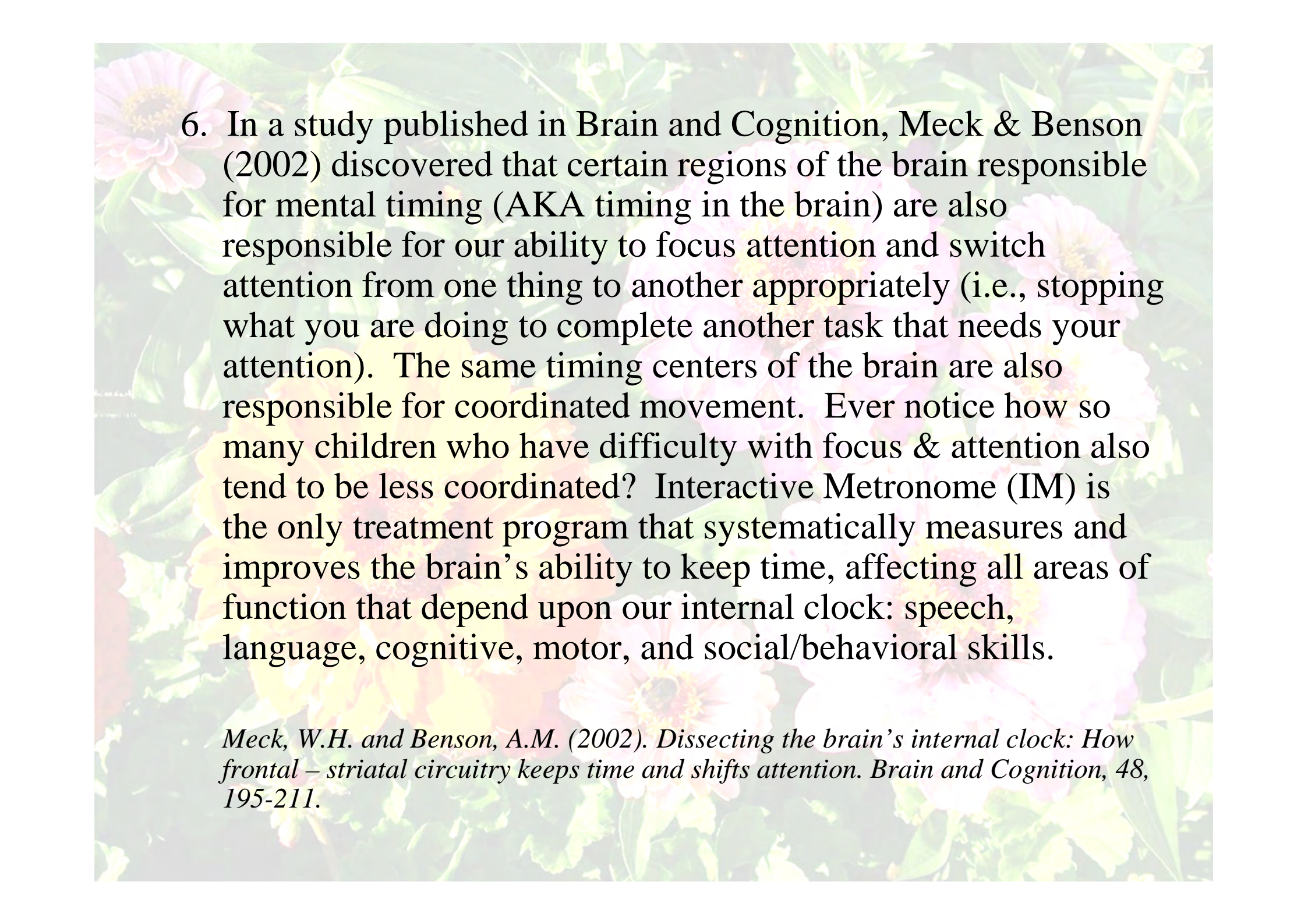
4. Sensorimotor synchronization or rhythmicity is subject to tempo changes, and the adaptation to these changes is proposed to be based on two processes. Phase correction, which is largely automatic, and period correction, which requires conscious awareness and attention (Repp, Keller, Repp, 2004). In this study, subject performed a finger-tapping task in synchrony with auditory sequences. The sequences contained a tempo change. Following that change, the participants were to continue tapping after the sequences ended. Whether to adapt to the tempo change was manipulated through verbal instruction.

- (Aschersleben & Bertleson, 2003; Hickok, Buchsbaum, Humphries & Muftuler, 2003; Repp, 2003).



5. A recent study by the Kennedy Krieger Institute (2011) showed that areas of the brain that control thinking and motor skills are different (smaller) in children with ADHD compared to other children. The specific regions of the brain that were mentioned are known to be involved in mental timing. Mental timing (AKA timing in the brain) is vital for many of our thinking skills and for good motor coordination. Studies have shown that timing in the brain is disrupted in children and adults with ADHD, leading to problems with focus, other cognitive abilities, and motor skills. Interactive Metronome, a patented non-medical treatment for ADHD, is the **ONLY** program that **simultaneously** works on thinking **AND** motor skills by specifically addressing and improving the areas of the brain responsible for mental timing.

Kennedy Krieger Institute (2011, June 10). Brain imaging study of preschoolers with ADHD detects brain differences linked to symptoms.



6. In a study published in *Brain and Cognition*, Meck & Benson (2002) discovered that certain regions of the brain responsible for mental timing (AKA timing in the brain) are also responsible for our ability to focus attention and switch attention from one thing to another appropriately (i.e., stopping what you are doing to complete another task that needs your attention). The same timing centers of the brain are also responsible for coordinated movement. Ever notice how so many children who have difficulty with focus & attention also tend to be less coordinated? Interactive Metronome (IM) is the only treatment program that systematically measures and improves the brain's ability to keep time, affecting all areas of function that depend upon our internal clock: speech, language, cognitive, motor, and social/behavioral skills.

Meck, W.H. and Benson, A.M. (2002). Dissecting the brain's internal clock: How frontal – striatal circuitry keeps time and shifts attention. Brain and Cognition, 48, 195-211.



QUESTIONS AND ANSWERS