Sensory Processing and Learning

Learning outcomes

- To understand sensory processing and the impact on learning
- To understand the impact of sensory processing Disorder(s)
- To provide a sensory lens to behaviour and engagement

Overview

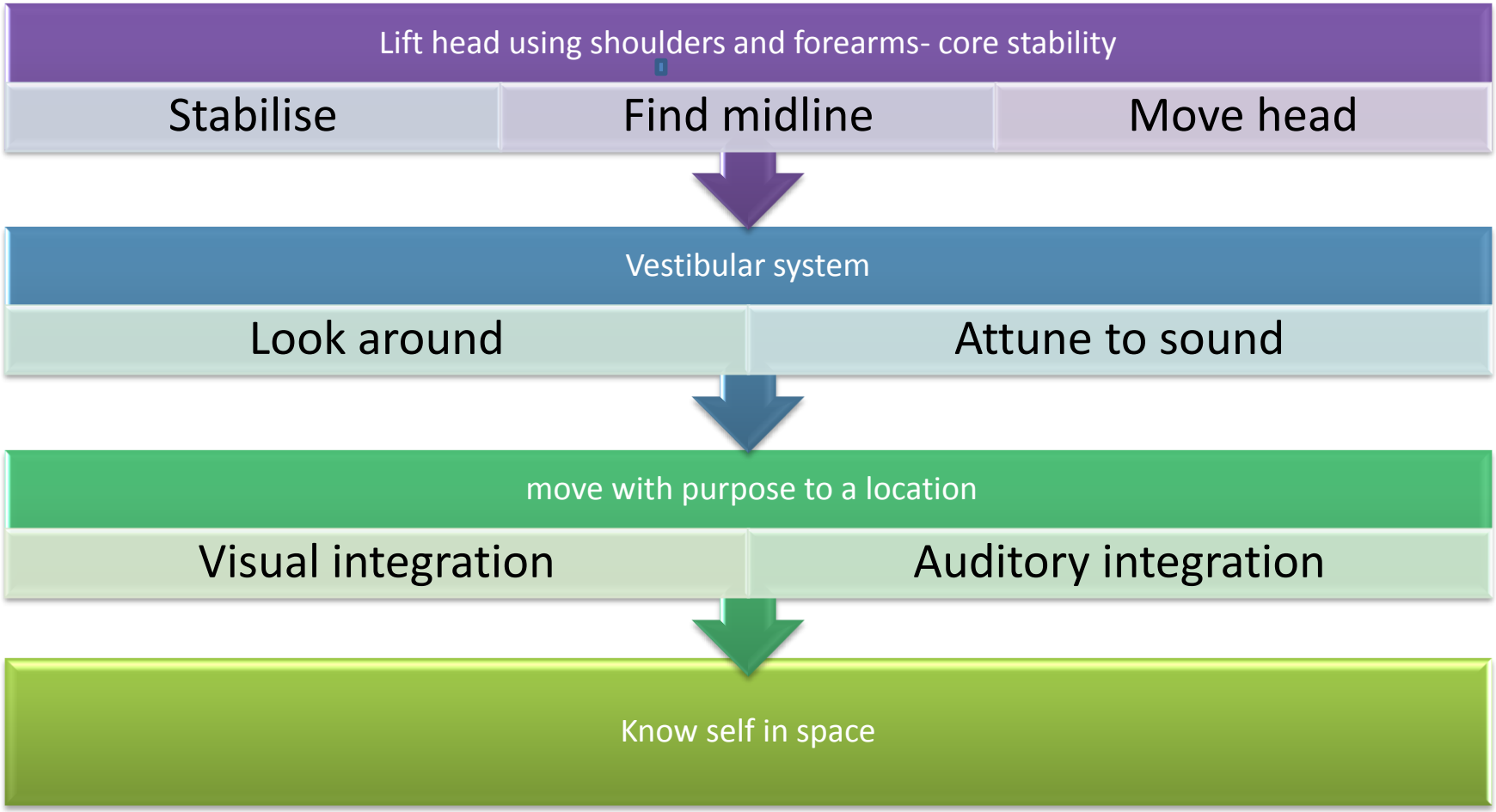
- Review of normal development – Global movement, Sensory, Communication, Cognitive, Emotional
- Attachment Theory
- Sensory Processing Disorder
- The 7 Senses
- What are you?
- What can we do to support sensory processing difficulties

Normal development – Global movement

Gross motor milestones:

By one month a baby will:	By three months	9 months	By one	By two
• visually track a toy or bright object • Turn to a persons voice	• Lay on tummy with head held up, hold an object for a short time, bring hands to mouth • 6 months sit independently, roll over, bear weight through their legs • Grasp feet reach and grasp a toy • Understand emotional state of mother and respond to it • Feed themselves with fingers, hold bottle/cup	• crawling is emerging, stacking bricks or cups (3) use pincer grasp, will play peek a boo, look at a book independently	• walking is emerging, cruising, crawl up stairs, drop a toy, throw a toy, hand dominance is emerging, can cross the midline for simple tasks, visually track across the midline, mark making emerging object permanence	• a child can jump, kick, run, build with bricks, eat with a knife and fork –emerging skill, may be toilet training

Developmental movement



Example of tummy time (3-4 months)

Normal development – Global movement continued

By three	By four	By six
• a child can ride a tricycle, kick a ball to target, use a dynamic tripod grasp, copy the letters V,H,T, cut with scissors, thread beads, draw a person with head and legs, learn a song with actions	• balance on a beam, jump over obstacles and off steps, can draw a picture on verbal request, can match colours can count to ten	• a child is reading, writing, measuring and pouring, jumping and running, hopping, dancing, cartwheels, direction change run down a hill and control speed

Normal development - Sensory

By one month-	By three months	By six months	By one
• focused gaze at 20-25 cm move head to source of sound, startle by noise, blink defensively when things come towards them	• move head to gaze around them, can focus eyes on one point	• turn to sound at ear level, adjust body to gain a better view, mouth and handle an object	• see nearly as well as an adult, respond to name being called, discriminate objects by touch alone, discriminate tastes of food

Normal development – sensory cont.

By two	By four
• stopped mouthing objects, be able to manipulate a toy by touch, discriminate and label hot, cold, wet	• a child will be able to know speed and direction, visually track the same as an adult, they will have feed-forward and feed back skills

Normal development - communication

By two days old	Until six weeks,	By four months,	Until six months	6-12 months
• the neonate can discriminate general sound vs language	• crying and fussing are the main methods of communicating	• cooing and laughter, and then raspberries & syllables begin the babbling.	• 'perlocutionary': we impose communciative significance on children's verbal and non-verbal behaviour.	• 'illocutionary': child develops behaviour consciously directed towards influencing others – intentional communication – pointing at objects, hands up to get picked up, wave 'bye', protesting by wrigging away or throwing themselves back.

Normal development – communication cont.

At one year,	At 18 months,	At two years,	At three years,
• understand 3-50 words & may be imitating some early words ‘ta’	• first 50 words, and understands many more	• understands two-word phrases, uses 50+ words (can be 200-300), will talk in long monologues during play (mostly incomprehensible to others)	• understands early questions, locations and concepts, following 2-step instructions, and developing understanding of early reasoning. Increase in words used & grammar use with many confusions and over-generalisations (3-5 word sentences), joins in rhyming, make-believe play.

Normal development – communication cont.

At four years,	At five,	Ongoing development through early school years:
• understands many more concepts including comparatives, and time-related vocabulary. Uses more complex sentences (4-8 words), including conjunctions 'so', 'because', continually asking questions ('why?' stage), listens to and tells long stories, sometimes confusing fact & fiction.	• will understand a sequence of three commands, can address specific requests for clarification, Speech is fluent and grammatically conventional, children will ask for meanings of abstract words, using 'hints', using narrative, uses jokes and riddles.	• Developing understanding of how others think and feel, predicting, problem solving, reasoning and inference.

Normal development – emotional

At 2 years	At 2 ½ years	At 3 years	At 4 years	At 5years
•understands size in relation to self, constantly demanding parent's or carer's attention – clings tightly in affection, fatigue or fear. Resistive and rebellious when told off. Tantrums when frustrated or in trying to make oneself understood. Attention is readily distracted. Defends possessions with determination. Resentful if attention is shown to other children.	•attention is still single-channelled, but some shift from task to directions and back to task if attention is fully gained. Little understanding of common dangers or need to defer immediate wishes, emotionally very dependent on adult, talking about absent objects.	•general behaviour more amenable, affectionate and confiding. Attention as above but this is now under the child's control. Seeks interaction with adults	•can give personal info (full name, address, and usually age). Behaviour is more independent and strongly self-willed. Will quarrel with playmates when wishes are crossed, needs companionship of other children – alternately co-operation and aggressive (words rather than physical). Understands turn-taking and sharing, shows concern and sympathy. In readiness for school at 5yrs, attention is becoming two-channelled, they can continue a task and assimilate verbal directions (listen to the teacher) at the same time.	•behaviour is more sensible, controlled and independent, chooses own friends and co-operates most of the time, understanding the need for fair play and rules, tender and protective towards young children and pets, will ask for help when needed, mature school-entry level attention, it's integrated, well-established and sustained.

Normal development - cognitive

Piaget's stages of cognitive development:

Sensory Motor Stage (0-2 years)

- Piaget believed that much of a baby's behaviour is triggered by certain stimuli, in that they are reflexive. A few weeks after birth, the baby begins to understand some of the information it is receiving from it's senses, and learns to use some muscles and limbs for movement. These developments are known as 'action schemas'.
- Babies are unable to consider anyone else's needs, wants or interests, and are therefore considered to be 'ego centric'.

Pre-Operations Stage (2yrs – 7 years)

- Pre-operational children are usually 'ego centric', meaning that they are only able to consider things from their own point of view, and imagine that everyone shares this view, because it is the only one possible. Gradually during this stage, a certain amount of 'decentering' occurs. This is when someone stops believing that they are the centre of the world, and they are more able to imagine that something or someone else could be the centre of attention.

Concrete Operations Stage (7-11 years)

- the thought process becomes more rational, mature and 'adult like', or more 'operational', Although this process most often continues well into the teenage years
- ego centric thought tends to decline during the Concrete Operational stage, although, remnants of this way of thinking are often found in adults.
- children gradually develop the ability to 'conserve', or learn that objects are not always the way that they appear to be. This occurs when children are able to take in many different aspects of an object, simply through looking at it. Children are able to begin to imagine different scenarios, or 'what if' something were to happen. This is because they now have more 'operational' thought.

Formal Operations Stage (11-16 years)

- When faced with a problem, adolescents come up with a general theory of all possible factors that might affect the outcome and deduce from it specific hypothese that might occur. They then systematically treat these hypothese to see which ones do in fact occur in the real world. Thus, adolescent problem solving begins with possibility and proceeds to reality.

ABC's of Attachment (Siegel 2004)

Attunement	• parents use of their own internal state to help regulate the infant
Balance	• a child's achievement of balance between its body, emotions and state of mind
Coherence	• sense of internal integration and interpersonal connectedness to others acquired by the child through its relationship with its parents

Attachment

Knowing primary carer

- Smell them
- Hear them
- Touch them

Enjoying primary carer

- I am calmed by their touch
- I listen to their singing

Being nurtured

- Fed
- Cleaned, cared for
- Soothed

Sensory

Sensory Processing Disorder Definition

- Sensory processing disorder (SPD) is a neurological disorder that results from the brain's inability to integrate certain information received from the body's five basic sensory systems. These sensory systems are responsible for detecting sights, sounds, smell, tastes, temperatures, pain, and the position and movements of the body. The brain then forms a combined picture of this information in order for the body to make sense of its surroundings and react to them appropriately. The ongoing relationship between behavior and brain functioning is called sensory integration (SI), a theory that was first pioneered by A. Jean Ayres, Ph.D., OTR in the 1960s.


The 7 Senses
Touch- tactile, feeling through our skin, including our lips and tongue
Taste and smell, olfactory
Sound-auditory
Sight- vision, including ocular motor function (behavioral optometry)
Body sense- proprioception
Movement sense- vestibular, the inner ear

Proprioception

- Proprioceptive information relates to feedback about the position and movement of the body. This information is received from receptors situated in our joints and muscles.
- It assists us in knowing where our body is in space and is important for developing adequate body and spatial awareness
- Proprioception helps our system regulate and often has a calming and orienting impact on a child who experiences Sensory Integration Dysfunction

Vestibular system

- Vestibular system refers to receptors located in our inner ears and tell us about the direction and speed we are moving in.
- This helps us modulate our own equilibrium

Vestibular Experiment

Willing volunteers needed

Ocular motor function

The engine/ muscles that control the eyes

Rapid localisation

Tracking and scanning

Bi-lateral integration

Visual closure

Vestibular-ocular reflex

Vestibular-ocular reflex

The vestibular-ocular reflex (VOR), describes the reflexive movement of the head in the opposite direction of the eye, keeping the image in the centre of the visual field.

Characteristics of ocular motor disorder

The signs and symptoms associated with ocular motor dysfunction may include, but are not limited to, the following:

- 1. difficulty visually tracking and/or following objects
- 2. loss of place, repetition, and/or omission of words and/or lines of print while reading
- 3. uses finger or pencil to avoid loss of place when reading
- 4. transposition when copying from one source document to another
- 5. diminished accuracy
- 6. inaccurate/inconsistent work product
- 7. inaccurate eye-hand coordination (missing markers, not negotiating obstacles, inconsistent catching and throwing)
- 8. unusual sitting posture/ unusual work positions (head close to paper, one eye closed, book to the side)
- 9. spatial disorientation/dizziness/motion sickness (dropping to the floor fear of playground equipment)
- 10. inconsistent visual attention/concentration or distractibility while performing visually demanding tasks, (copying, puzzles)
- 11. difficulty sustaining near visual function (reading, threading)
- 12. general fatigue
- 13. poor coordination skills clumsiness

Auditory processing

Filtering, dampening

Orienting, localising

Processing to language

Responding appropriately- flight or fight

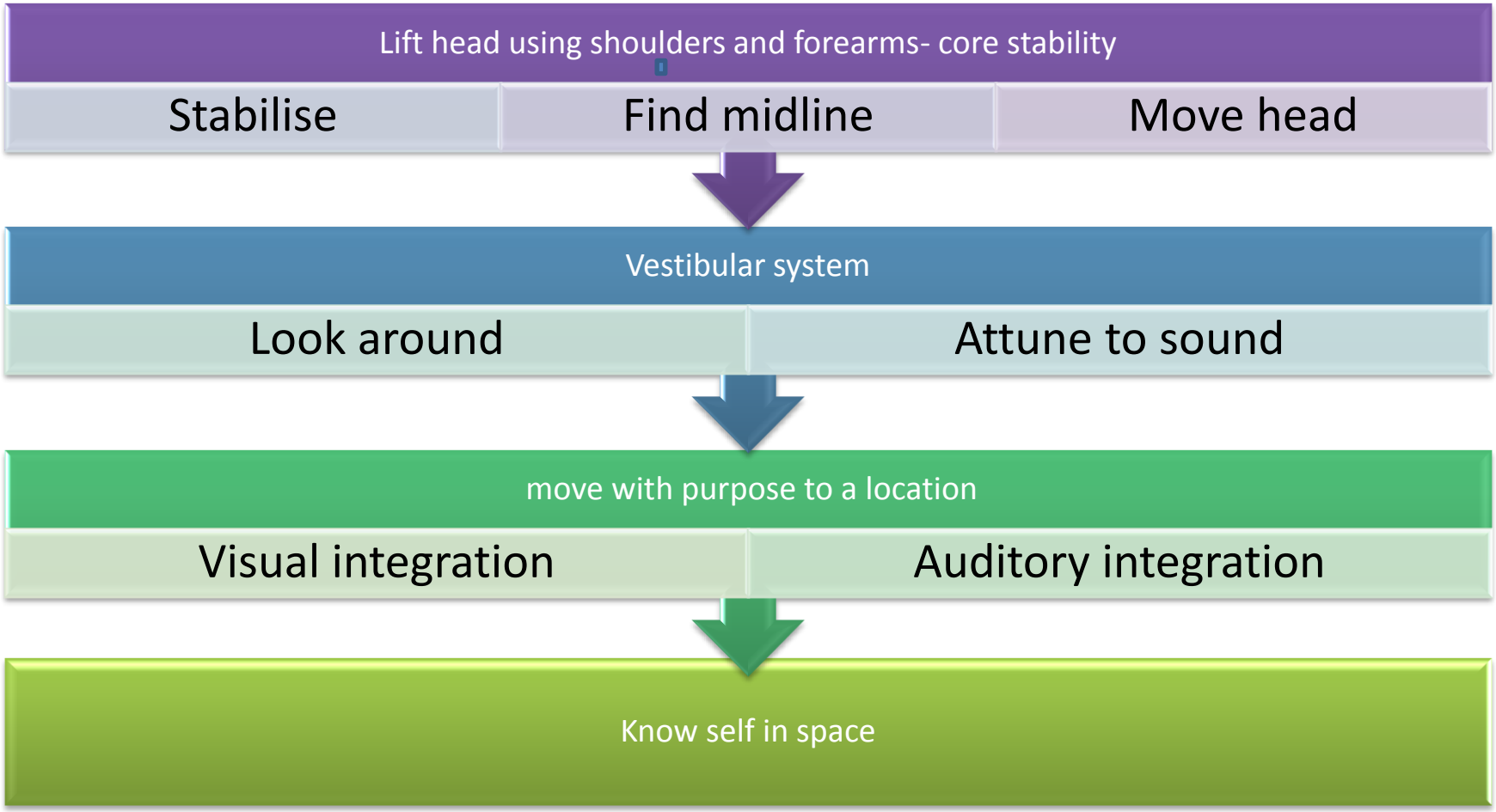
Characteristics of Auditory Processing Disorder APD

- **Auditory Figure-Ground Problems:** when a child can't pay attention if there's noise in the background. Noisy, low-structured classrooms could be very frustrating.
- **Auditory Memory Problems:** when a child has difficulty remembering information such as directions, lists, or study materials. It can be immediate ("I can't remember it now") and/or delayed ("I can't remember it when I need it for later").
- **Auditory Discrimination Problems:** when a child has difficulty hearing the difference between words or sounds that are similar (COAT/BOAT or CH/SH). This can affect following directions, and reading, spelling, and writing skills, among others.
- **Auditory Attention Problems:** when a child can't stay focused on listening long enough to complete a task or requirement (such as listening to a lecture in school). Kids with CAPD often have trouble maintaining attention, although health, motivation, and attitude also can play a role.
- **Auditory Cohesion Problems:** when higher-level listening tasks are difficult. Auditory cohesion skills — drawing inferences from conversations, understanding riddles, or comprehending verbal math problems — require heightened auditory processing and language levels. They develop best when all the other skills (levels 1 through 4 above) are intact.

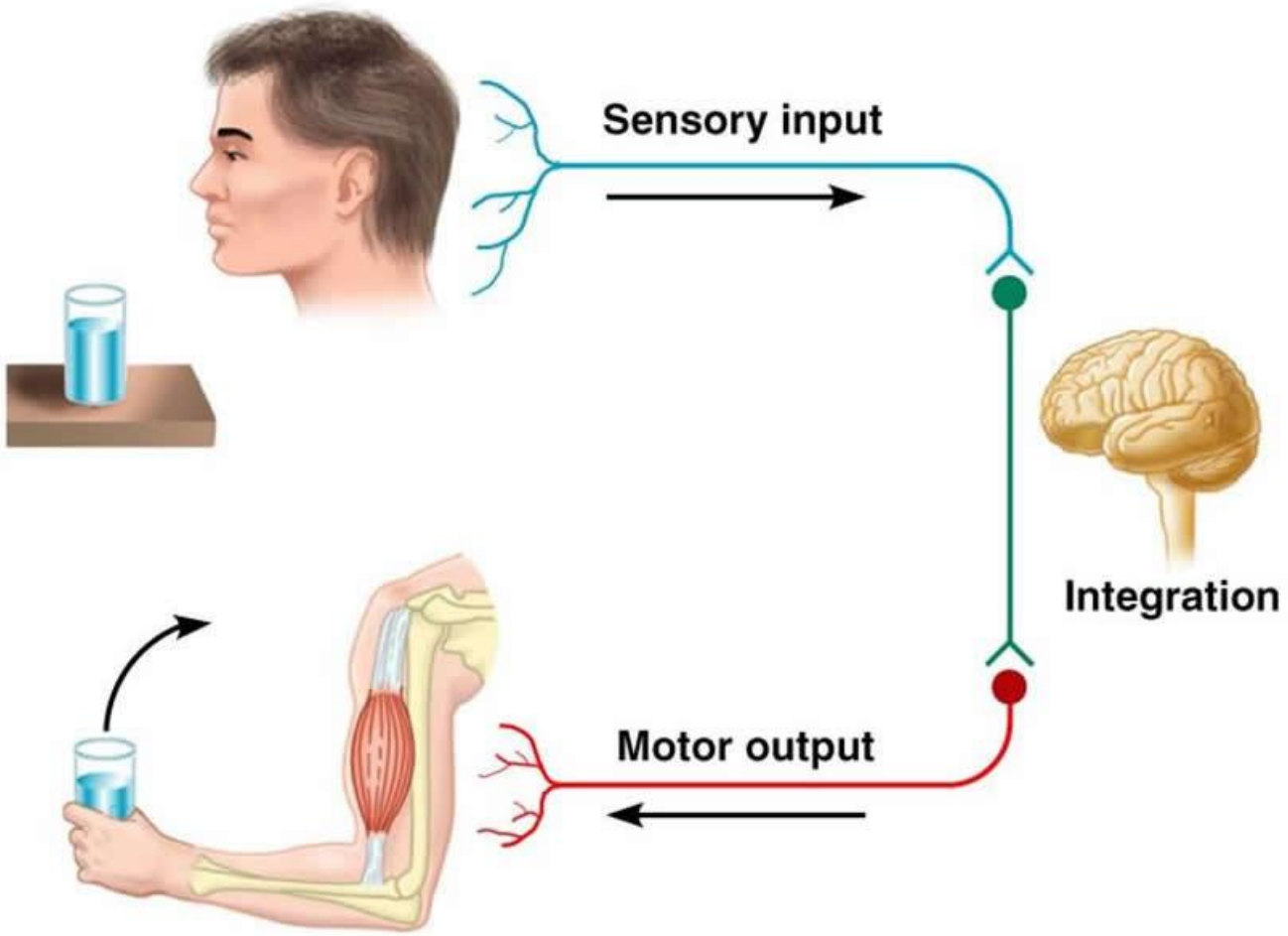
Self in space

- Knowing body position
- Depth perception
- Proprioception
- Vestibular
- Auditory

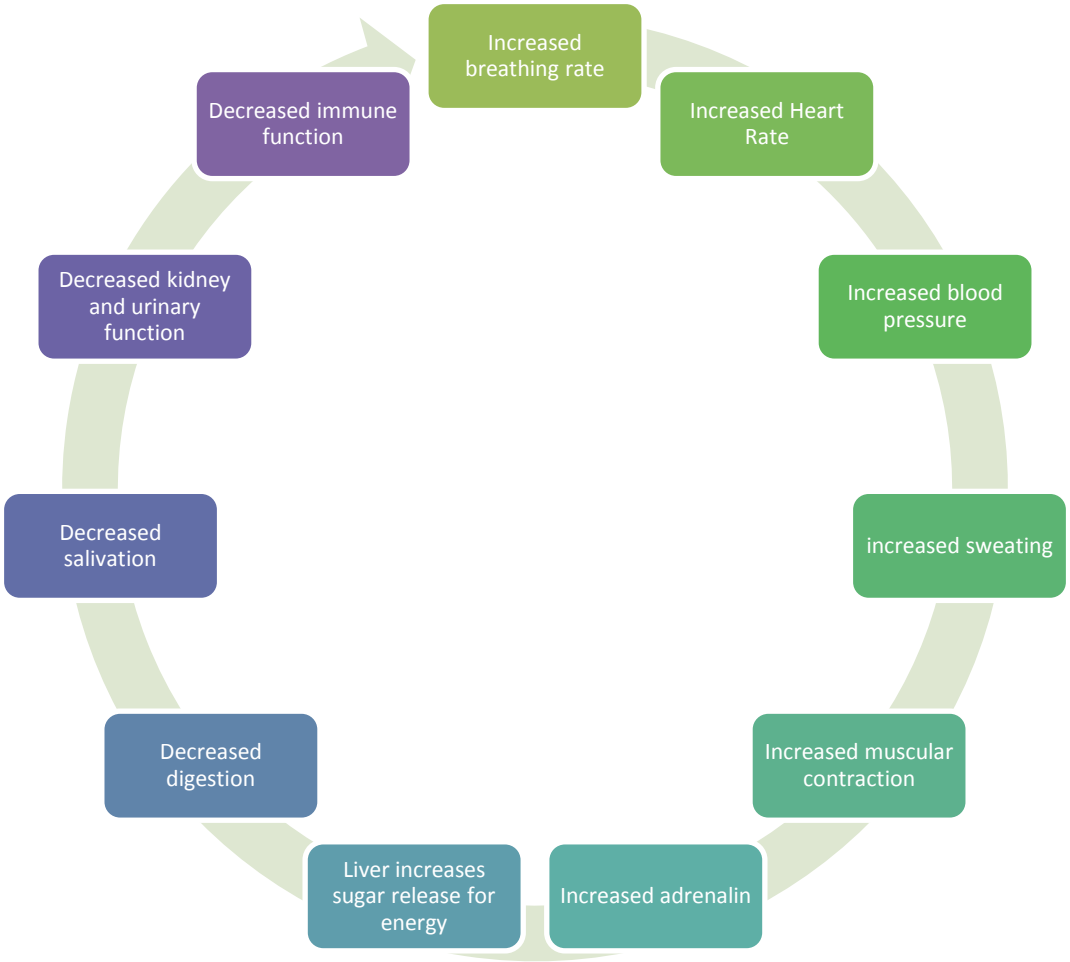
Developmental movement



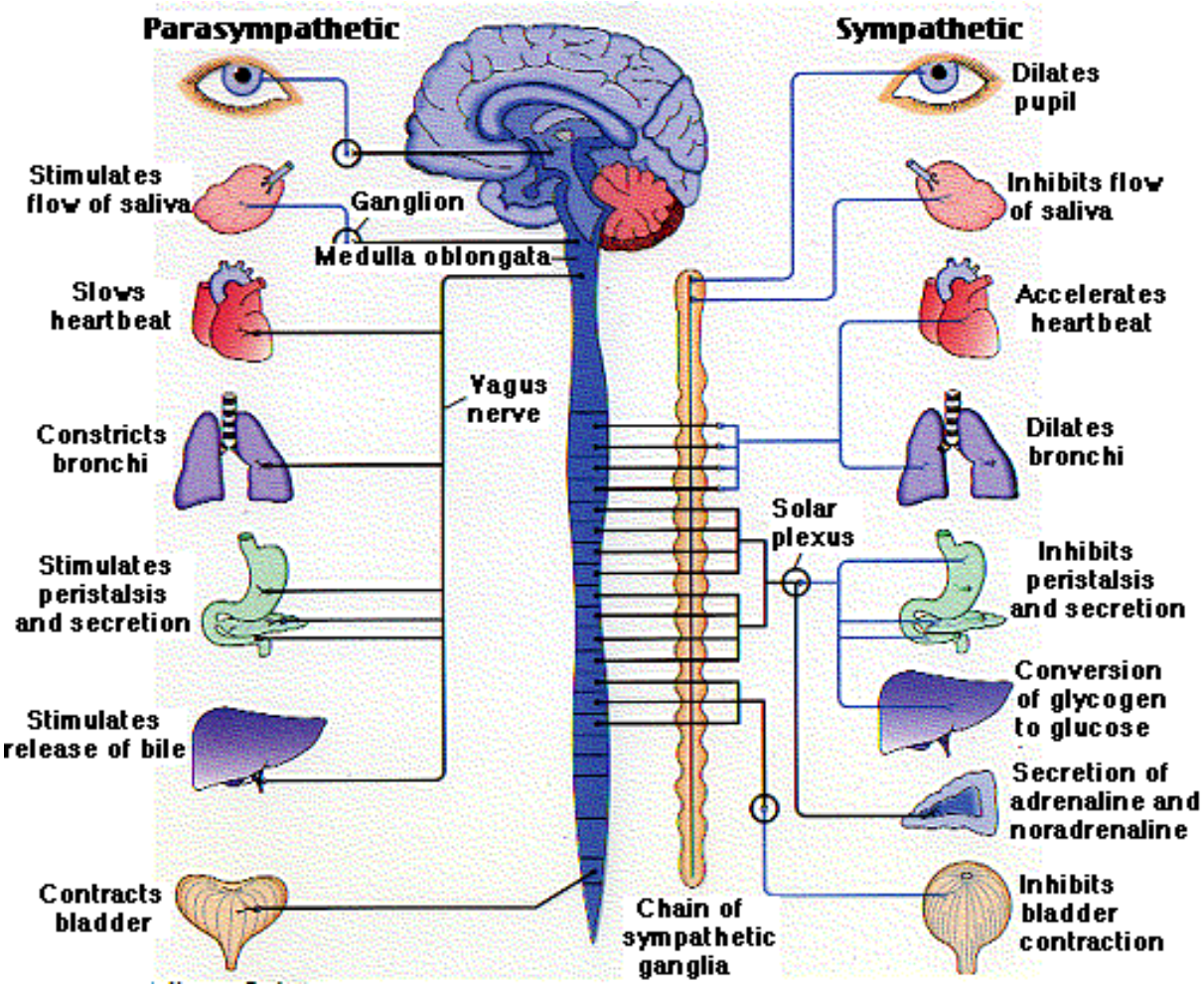
The central Nervous system



Flight or fight



Sympathetic and Parasympathetic



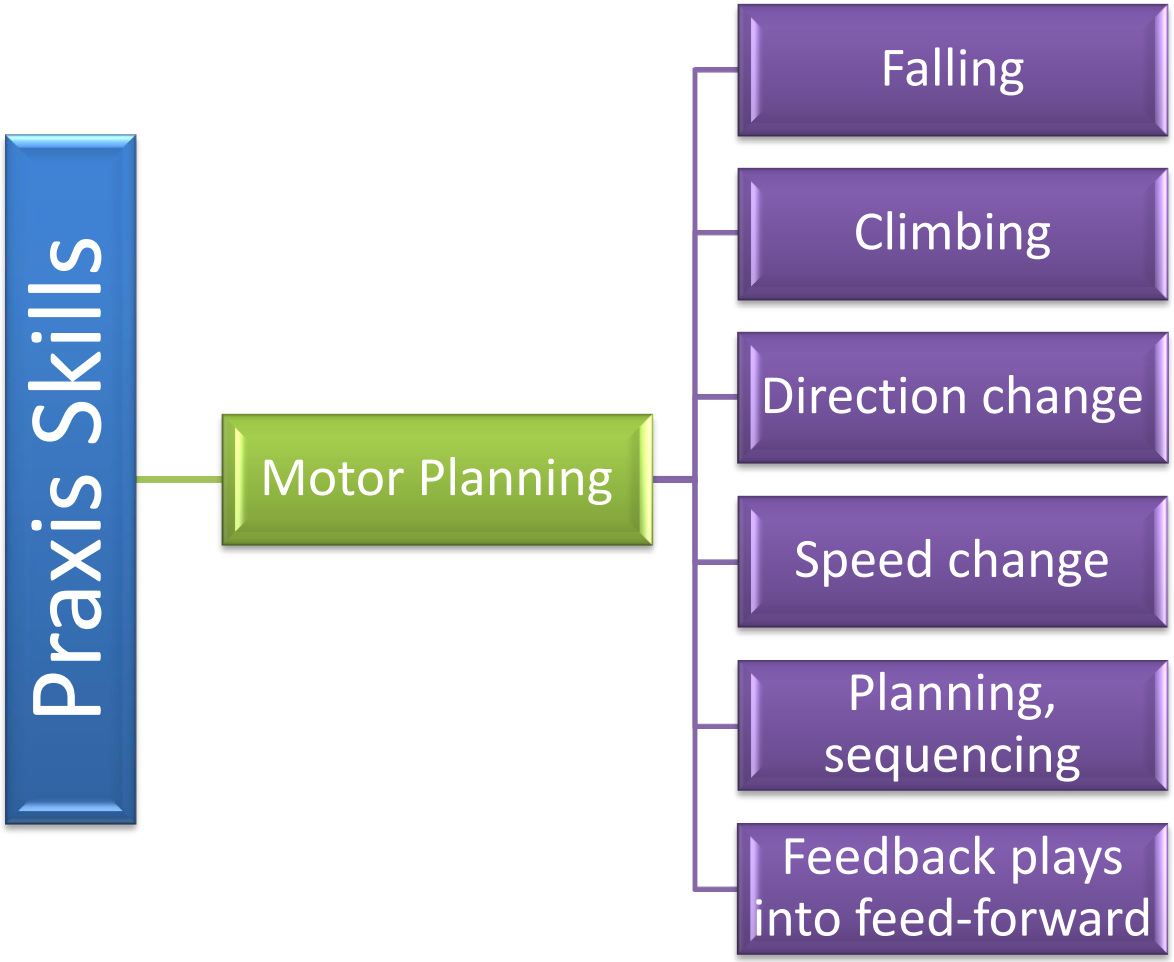
Primal responses

- We are sensory beings
- We will fulfil these needs first
- We need to know ourselves in relation to space
- We need to be able to master and fulfil our sensory needs
- we need to feel secure and safe

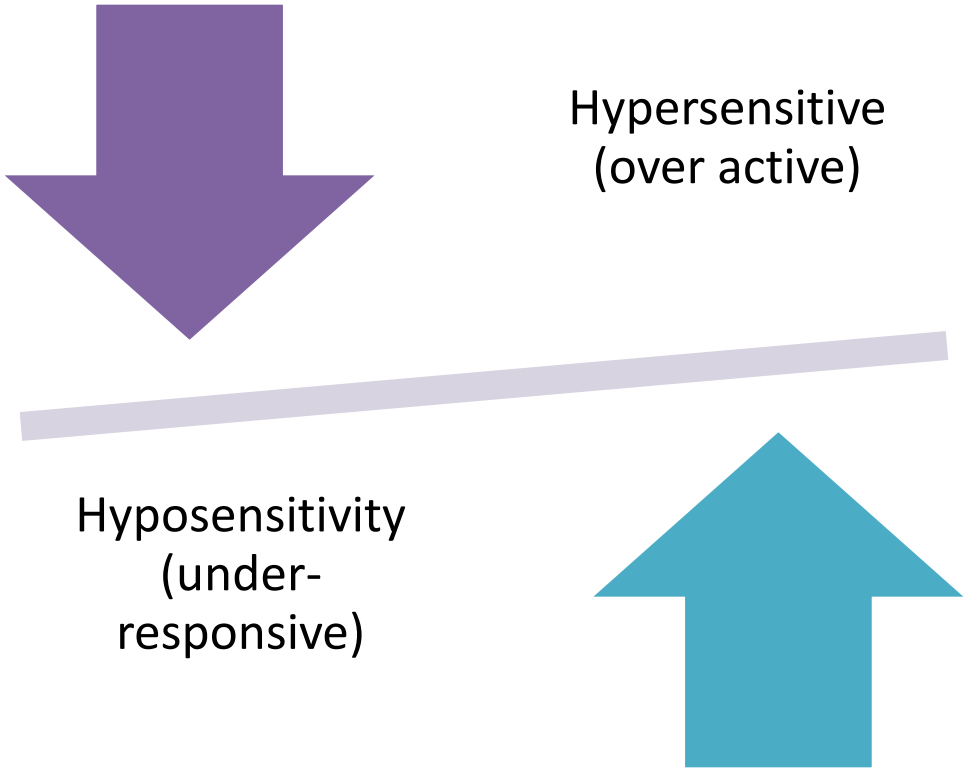
It is not a primal need to…

- Eat
- Drink
- Learn
- Sleep

Adaptive response



Hyposensitivity and Hypersensitivity



The hyposensitive

May not notice being touched, Appearing clumsy or heavy handed, squeeze and bang

Seeks stimuli- biting/ mouthing, noise making, movement seeking, head butting/ shaking, spin and flap

Can appear listless and passive

The Hypersensitive Child
'The Sensory Avoiding Child'

Avoid textures such as fabrics, teddy bears, messy hands

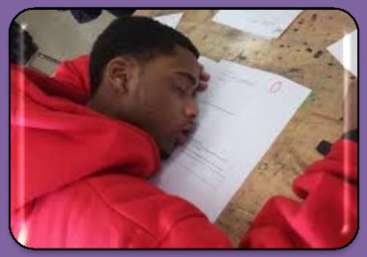
Too loud, too bright, too fast, too much

They can be ridged about routine, difficulty maintaining attention

Shut Down

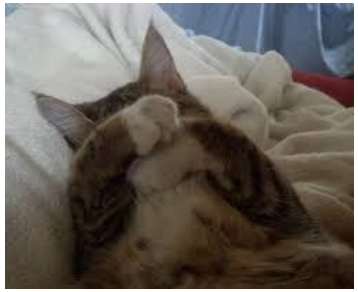
bombarded with sensory information

Information comes too fast, too bright, too loud or from to many stimuli



disengaged, appearing flat and unresponsive

What are you?



Theory becomes practice

What to do next

- Sensory strategies for the classroom
- Creating a safe environment
- Think about sensory Vs behaviour

Resources

- Lucy Miller -Sensational Kids
- No longer a secret by Doreit Bialer and Lucy Jane Miller
- Sensory Integration and The child, 25th revised edition Jean Ayers
- Building Bridges through sensory integration
- http://www.intensiveinteraction.co.uk/about/
- http://www.eyecanlearn.com/
- http://www.vitallinks.net/
- http://spdfoundation.net/books.html
- http://www.sensoryconnectionprogram.com/sensory_defensiveness.pdf

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Ocular Motor Function and use of AAC

- Development of ocular motor function (whistle stop tour)
- AAC pro's and cons (OT perspective)
- Why are we talking to an OT not a behavioural Optometrist - the OT role in ocular motor and visual processing function
- Whole body approach to ocular motor function and rehabilitation

Development of vision

Up to three months of age

- babies' eyes do not focus on objects more than 8 to 10 inches from their faces.
- may look intently at a highly contrasted target, babies have not yet developed the ability to easily tell **the difference** between two targets or **move their eyes** between the two images.
- Their primary focus is on objects 8 to 10 inches from their face By eight weeks, babies begin to more easily focus their eyes on the faces of a parent or other person near them

First five months of age

- the eyes start **working together** and vision rapidly improves
- Eye-hand coordination begins to develop as the infant **starts tracking** moving objects with his or her eyes and reaching for them.
- Babies should begin to **follow moving objects** with their eyes and reach for things at around three months of age

Five to eight months of age

- During these months, **control of eye movements and eye-body coordination** skills continue to improve.
- Depth perception, which is the ability to judge if objects are nearer or farther away than other objects, is not present at birth.
- It is not until around the fifth month that the eyes are capable of **working together to form** a **three-dimensional view** of the world and begin to see in depth.
- Although an infant's colour vision is not as sensitive as an adult's, it is generally believed that babies have good colour vision by five months of age.

Development of vision continued

Nine to twelve months

- By the age of nine to twelve months, babies should be using their **eyes and hands** together.
- Babies can now **judge distances** fairly well and throw things with precision.

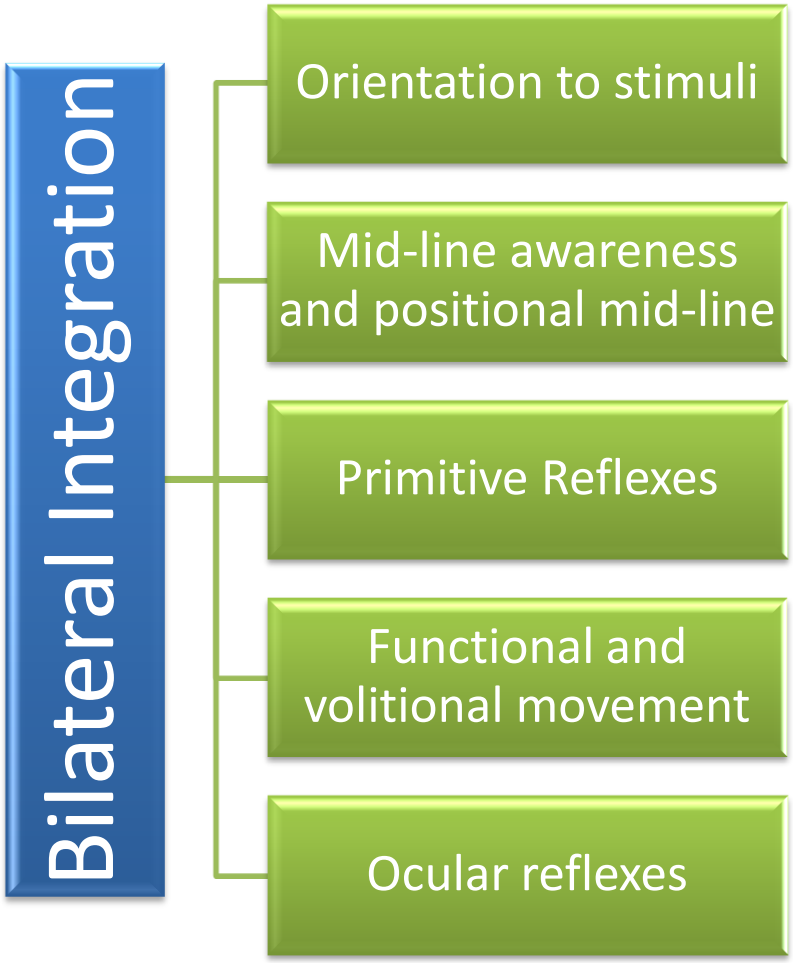
One to two

- By two years of age, a child's eye-hand coordination and **depth perception should be well developed.**
- Children this age are highly interested in exploring their environment and in looking and listening.

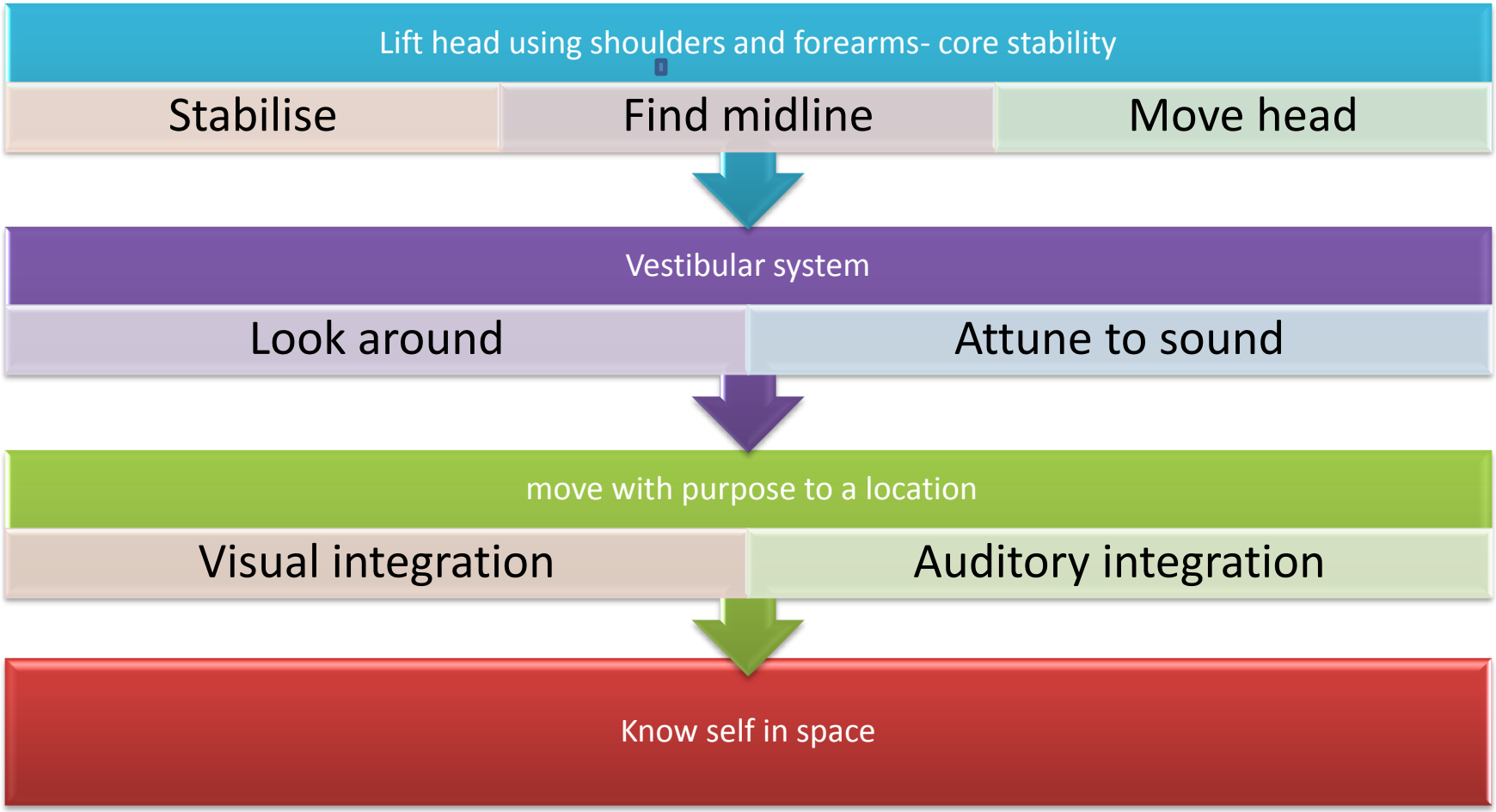
Two to three

- Can recognise abstract images
- Can scribble/ make marks
- Can throw to target

3D, bi-lateral function



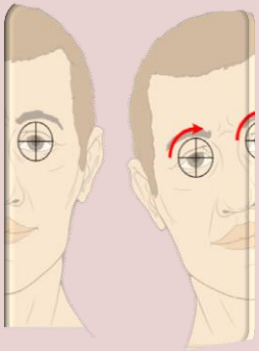
Developmental movement



Example of reporting

- **Visual-** client found rapid localisation difficult and struggled to stabilise his visual field. This means looking from one place to the other quickly and visually finding a location smoothly. This may impact on his ability to orientate himself to his environment when moving quickly e.g. during sports activities. client enjoys movement but found movement in his visual field more challenging and disorienting. client found it difficult to track through the visual mid line during isolated eye movement tasks. This indicates that client has reduced ocular motor function, describing a decreased function of the muscles that control the motor aspect of the eyes. A mid-line jump in tracking tasks demonstrated that the eyes are poorly integrated- working together bi-laterally. This will impact on his ability to engage in group sports, such as throwing, catching or running in a busy playground. Academically it will impact on copying, reading, finding meaning in pictures and often finding meaning in facial expression and body language. When eyes are poorly integrated and lack muscular control seeing the whole is difficult, parts of an image are missing, depth perception is reduced. Ocular motor delay is commonly associated with poor vestibular function, poor muscular tone and is common in children who have missed the opportunity to crawl in infancy. client experiences all of the aforementioned influences upon developmental experience.

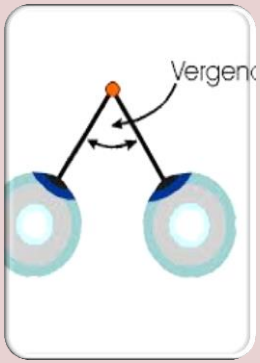
6 types of eye movement



VOR (Vestibulo-ocular reflex)- eyes move in opposition to head

Gaze holding- ability of eye to remain still whilst looking at an object

Saccades -are quick, simultaneous movements of both eyes in the same direction.



Vergence- eyes move towards each other as objects get closer

Smooth pursuit- smoothly follow objects

OKR (Optokinetic reflex)- the eyes ability to follow a moving object while the head remains still

Experiment

Experiment

- Find a partner
- Take it in turns to track a pencil while keeping your head still
- Look for smooth movements
- Look for visual jumping
- Do you feel queasy

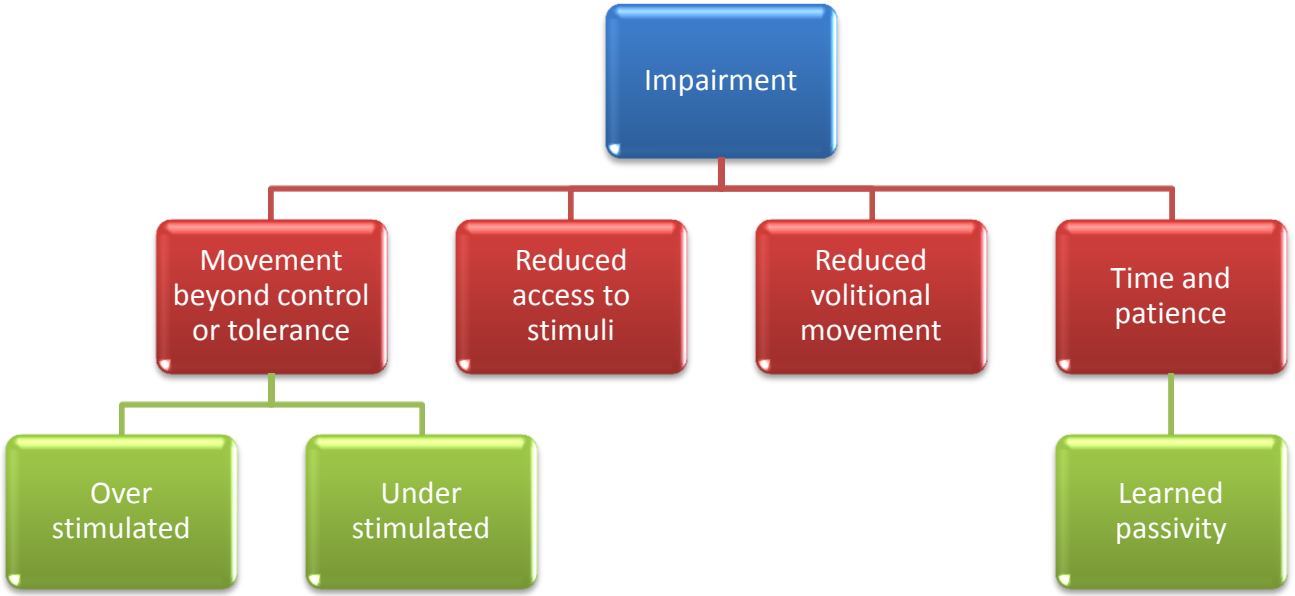
Experiment Part two

- Stimulate vestibular system
- Repeat eye test

visual system and vestibular system

- **Vision** is an important component of the vestibular system. About twenty percent of visual neurons respond to vestibular stimulation
- **Vestibulo-ocular movements** stabilize the eyes relative to the external world, compensating for head movements.
- **Reflex** responses prevent visual images from “slipping” on the surface of the retina as head position varies.
- **The action of vestibulo-ocular movements-** enables fixating on an object and moving the head from side to side; the eyes automatically compensate for the head movement by moving the same distance but in the opposite direction, thus keeping the image of the object at more or less the same place on the retina.
- **The vestibular system detects brief**, transient changes in head position and produces rapid corrective eye movements.
- **Sensory information** from the semi-circular canals directs the eyes to move in a direction opposite to the head movement. While the vestibular system operates effectively to counteract rapid movements of the head

For clients with physical impairment



Vestibular why it matters

Impact on vision and hearing processing

CNS dysfunction

Limited volitional movement

Reduced feedback

Inhibited feedback

Using visual tracking and AAC (eye Gaze)

1. Surface electrodes placed around the eye to provide data on relative eye movement within the head
2. Remote video imaging of a specific feature on the eye to measure eye movement
3. Contact lenses to track eye movements
4. Shining an infrared beam into the eye to track visual line of gaze (Donegan et al., 2005)

Positive's

- Eye gaze is natural and fast
- eye muscles display little fatigue
- eye gaze carries information about the person’s attention and focus
- usually there is nothing attached to the individual which is necessary for operation of the system (Hyrskykari, Majaranta & Räihä, 2005).

Negatives

- Inaccurate within a small area (approximately 1^{o}), thus making it difficult to select small items;
- Effortful, because many eye movements are subconscious and thus effort is required to bring them under conscious control
- Challenge between input and output of data requiring careful coordination of reading for input by putting eye selection output aside.
- Expensive
- Difficult to calibrate
- Lengthy training
- need to consider prior visual problems
- Lengthily set up time frame
- Head control and seating system dependent
- MDT approach is complex and costly

Other devices/ aids

- Head switches
- Mouse pads
- Mouth switches
- Joy sticks
- Pictures

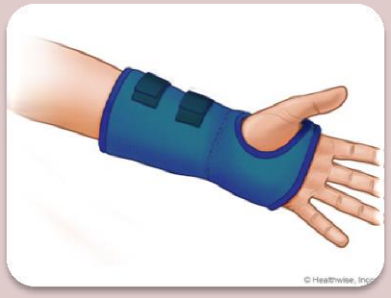
Questions to Consider

- Tracking
- Focus
- Bi-lateral integration
- Environment – lighting, noise, visual distraction tactile stimuli
- Visual field
- Visual distance

The OT role

Seating

head control and positioning



Splinting, environment, adaptation

Rehabilitation, therapy, treatment

Consultation

Resources

- http://www.novitatech.org.au/
- **The Handbook of Augmentative and Alternative Communication** edited by Sharon Glennen, Denise C.
- **Neuroscience. 2nd edition.**Purves D, Augustine GJ, Fitzpatrick D, et al.,2001.
- http://www.aoa.org/
- M.C. Brodsky, Pediatric Neuro-Ophthalmology, Springer Science+Business Media, LLC 2010
- Collage of Optometrists in Vision development
- The Star Centre