Writing and Neurological Development

NEUROLOGICAL AREA OF DEVELOPMENT	EFFECT ON WRITING
Palmar Reflex The Palmar Reflex is fully present at birth and is supposed to be inhibited by two to three months of life. Light touch or pressure to the palm of the hand results in closure of the fingers (recall how a young infant holds on to a person's finger with such a strong grip). In young infants, the Palmar Reflex can be elicited by sucking movements.	If the Palmar Reflex is retained, a child cannot proceed through the subsequent natural stages of release and finger mobility. As a result, the child will not fully develop the proper pencil grip for writing. If the Palmar Reflex is partially retained, a child may expend energy to keep it from "taking over"; such attention then distracts from the writing task. In cases where the Palmar Reflex is more aberrant, a child may also lick his lips or twist his mouth in some way when writing (the result of the original neurological loop that connects the palms with mouth movement); such "overflow" behavior is often ridiculed by others.
Moro Reflex The Moro Reflex is an involuntary reaction to threat. Since a baby cannot yet determine whether a threat is real or not, the brainstem releases an immediate Moro response that acts in the same way as an emergency trip-switch. This reflex is supposed to be inhibited at two to four months of life.	If the Moro Reflex is retained, a child is basically wired to go into a flight or fight mode whenever she perceives a threat—regardless whether the threat is real or imagined. As a result, a writing assignment may cause a child to go into "fight" (e.g. "I hate writing!) or into flight (e.g. "My stomach hurts."). A retained Moro Reflex may result in hypersensitivity in one or more sensory channels (since the body is always in an "alert" state of awareness). As a result, a child may have difficulty shutting out background noises and other background stimuli while trying to write.
Tonic Labyrinthine Reflex (TLR) The Tonic Labyrinthine Reflex provides the infant with a primitive response to the problem of gravity, exerts a tonic influence on muscle tone throughout the body, and helps the baby learn about balance. The TLR forwards should be inhibited by four months; the TLR backwards may take up to age three to inhibit.	A retained TLR "pulls" the child to the floor, resulting in a slouched posture or appearance of sinking into the chair; such posture is not conducive to writing. With a retained TLR, a child will experience difficulty in judging space. A sense of direction depends on our knowledge of where we are in space. If a child's point of directional reference is faulty, then this will cause reversals in writing and problems orienting words on a page (e.g. "seeing" the top, bottom, sides of a page). If the TLR is retained, a child goes through life as if he or she were positioned on a tight rope above the ground. This lack of gravitational security distracts from the writing task.

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Asymmetrical Tonic Neck Reflex (ATNR) The Asymmetrical Tonic Neck Reflex helps the infant to learn how to move, one side at a time. When this reflex is present in young babies, their arms and legs straighten on the same side that they are looking at; on the opposite side, the arms and legs are bent. The ATNR position helps a young baby learn how to visually fixate on objects. It also develops hand-eye coordination as the baby then reaches for an object in sight. The ATNR should be inhibited by six months of life.	A retained ATNR makes it very difficult to automatically cross the midline. This then delays development of the corpus callosum, the bundle of nerves that makes communication between the two brain hemispheres accessible and efficient. Trying to write without good communication between the hemispheres is almost impossible as each hemisphere contributes differently to the process of writing (e.g. the right hemisphere may generate creative ideas; the left hemisphere then organizes and sequences the ideas). Since a retained ATNR creates an invisible barrier to crossing the vertical midline, a child's body will want to execute tasks using *just one side at a time*. This approach impairs bilateral coordination; bilateral coordination is needed to write since one hand creates words with the pencil while the other hand stabilizes the paper. A retained ATNR makes it almost impossible to achieve good penmanship. Since head movement triggers this reflex, a child's arm is "wired" to straighten and his hand is "wired" to open whenever a child turns his head to look at the paper. When he then turns his head to look to another paper (e.g. when copying a draft to a final copy), the head movement then makes the arm bend. This subtle back-and-forth action on the pencil results in poor penmanship. A child must expend great energy to thwart the back-and-forth movement. As a result, a child with a retained ATNR tires quickly when writing. A child may discover how to compensate for a retained ATNR by either turning the paper to a 90-degree angle, not turning the head (viewing a draft out of the corner of the eye), using an immature pencil grip, or using excessive pressure. Regardless, the physical act of writing will always require such intense concentration at the expense of cognitive processing that both the quality and quantity of writing will be affected.

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Symmetrical Tonic Neck Reflex (STNR) The Symmetrical Tonic Neck Reflex helps the baby defy gravity by getting off the floor and on to the hands and knees. The STNR also helps complete a sequence of eye training: the baby learns to fixate his eyes at far and near distances, which then train the baby's brain for binocular vision. Whereas the ATNR divides the body at a vertical midline, the STNR divides the body at a horizontal midline. The STNR should be inhibited by nine to eleven months of life.	If the STNR is retained, a child will have trouble with vertical tracking; vertical tracking is needed to follow movement from the top to bottom of a piece of paper when writing. A retained STNR will cause a child to slouch severely or put his head on the desk while writing. Such position is not conducive to writing. Without good binocular vision, words will look blurry and distorted.
Postural Reflexes While the primitive reflexes lay the foundation for future functioning, the postural reflexes form the framework for which other systems can operate effectively. In contrast to primitive reflexes (which become inhibited), postural reflexes emerge and are intended to stay "on" throughout life. The transition from primitive reflex reaction to postural control is gradual; there is a period of time where both reflexes are operating together. Over time, the more mature postural reactions become automatic. Such reflexes affect posture, movement, and stability.	The postural reflexes form part of a main highway of connections from the motor cortex to the muscles. "Pot holes" in this highway are going to cause problems in the physical act of writing. While alternate routes can be used, they will not be as efficient. When postural reflexes have not fully emerged, balance, controlled eye movements, and visual perception are impaired. If a child lacks equilibrium, his or her reactions tend to be viewed as clumsy and uncoordinated. Writing requires good coordination. If a child lacks controlled eye movements, then words will not appear "still" on the page, and spacing of words will be irregular. A child with visual perception problems will have difficulty seeing the differences between similar letters and words, and therefore, will have difficulty writing intended words.

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Eye Movement Skills The eyes need to keep still on a target (they must rest on a word for at least 1/4 of a second for the brain to register the information), make smooth and accurate jumps from one fixation to the next, and track without moving the head.	When eye movement skills are poor, a child may overlook obvious errors when proofing work or ignore corrections on a draft when writing a final copy. In such cases, the eyes have skipped over words—sometimes even complete lines—when making jumps between fixations. Poor eye movement skills may also result in inconsistent spacing between letters and words.
Focusing Skills Good focusing skills make it easy to quickly and accurately shift focus from varying distances within one second.	Poor focusing problems will require a longer time to produce a final copy from a draft since it may take 10-12 seconds per shift of focus (as opposed to the expected one second) to see words clearly enough to recognize and process them. There may be a notable deterioration in the quality of the work as it progresses as the child continues to shift focus, back and forth, from the draft to final copy and vice-versa. The deterioration and length of time to complete final work may be misinterpreted as carelessness and being inattentive to the task.
Form Perception and Reproduction Good form Perception and Reproductions skills make it easy to see and apply reference points to distinguish one form from another and to reproduce such forms with accuracy.	When Form and Reproduction skills are not developed, a child may erase letters and words multiple times; such work is often perceived as being sloppy. Multiple erasures interrupt the creative thought process.

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Visual Figure-Ground Skills Good visual figure-ground skills make it easy to see the foreground, regardless of the presence of background stimuli.	When visual figure-ground skills are not developed, a child may have difficulty keeping the words "in front" and the paper in the background. Such distraction makes it difficult to stay focused on the writing assignment.
Visual Imagery Good visual imagery skills make it easy to recall patterns, create specific images in the mind's eye, and to use such images to "plan."	When visual imagery skills are not developed, spelling will be poor since there is no mental image to determine whether a word "looks" right or not. If a child has not learned how to create visual images that match specific words, envisioning details and action prior to writing will be limited or nonexistent. Without the ability to first plan in the mind's eye, work may not reflect organized thought.
Laterality and Directionality Good laterality and directionality skills make it easy to move across the midline with ease and to distinguish between left and right, up and down.	Without laterality and directionality skills, there is no automatic perception of how words should be presented and organized on the page (e.g. there is no automatic sense of top or bottom or margins). Moving from left to right and crossing the midline while writing also may not be "natural."
Vestibular Processing Good vestibular processing helps us know how we're moving in relationship to gravity (whether we are upright, upside down, moving sideways, spinning, etc.). This sensory system also helps us retain balance, keeps us alert, and stabilizes the visual system.	Movement, such as rocking and spinning, turns on a sluggish vestibular system; this kind of movement is contrary to sitting still (which is required to write). Since all senses are processed in reference to vestibular processing, other senses will be impaired when trying to write if vestibular processing is poor. Since the vestibular system is a "tripod" for the visual system, inefficient processing will cause a child to see words moving and jumping around a page (similar to viewing a video that was filmed with an unstable hand).

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Proprioceptive Processing Good proprioceptive processing helps us know where body parts are and what they are doing without looking at them. This sensory system also helps us make postural adjustments and know how much force is needed to hold an object.	If the brain is not sending accurate messages (or not sending them quickly enough) to the very small muscles in the fingers, the fingers fail the child when writing: If there is too much muscle movement and too little stabilization, then the pencil grip is unstable and constantly changing. If the opposite occurs (too much stabilization), then the child holds the pencil close to the page and with great pressure. When proprioceptive processing is poor, a child may find ways to get such information by doing movements (e.g clicks heels against the floor, chews on pencils or hood strings). When a child is preoccupied with ways to improve his proprioceptive processing, he or she cannot give full attention to the writing task.
Tactile Processing Good tactile processing helps us ignore unimportant tactile sensations and learn about the environment through touch experiences.	If the protective part of the tactile system is still dominant past the first year of life, ordinary touch sensations register from annoying to painful. When a child is preoccupied with distorted touch sensations (e.g. clothing tags, the texture of the top of the desk, an air vent blowing on the skin), then he or she cannot give full attention to the writing task.