

The Rational for the In Your Pocket® Weighted Vest©

An Instrumental Tool to Facilitate Behavioral Change in Children with Dysfunctional Patterns of Sensory Integration

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Background

For over a decade the medical community has come to know the term Dysfunctional Patterns of Sensory Integration or Sensory Processing Disorder (SPD). SPD occurs when the brain inefficiently processes sensory messages coming from a person's own body and their environment (Kranowitz, C, 2003). Sensory messages are derived from the five senses, hearing, smelling, tasting, sight or vision, and touch. Other vital senses for understanding SPD are vestibular and proprioceptive senses.

The sense of touch or the tactile sense is the way in which our cells receive sensations either actively or passively from head to toe. The vestibular system provides the connection between balance and movement and gravity. The system responds to changes in head position, to body movements and the pull of gravity. These receptors or nerve endings are in the inner ear and convert into nerve impulses that allow us to move smoothly and efficiently.

Proprioception or "the position sense" is the sense in which our muscular system relates to where our body is in space and what the body is doing. It is a distinct sensory concept that provides reaction solely on the status of the body internally. With typical body movements our brain is helping us adjust our body to the world around us. In this aspect, the brain is functioning "automatically" or in the background – the person is unaware. These unaware sensations come to the brains proprioceptors or sensory nerves provided by information from the joints, muscles, tendons and ligaments. The sensory nerves supply information about whether the body is moving with required effort, as well as where various parts of the body are located in relation to each other.

In order to understand the integration of all our senses to function efficiently and process the world around us, we must begin with the visual skills of infants and children. The child must, throughout infancy and childhood, learn to interpret that which is viewed and to organize it in relation to itself and other objects. As the child grows the visual mechanism undergoes changes which serve to reorient the ever changing and growing individual (Gessell et al., 1949). One such system is the development of depth perception. Depth perception is defined as the visual-

spatial processing skill of seeing objects in three dimensions and judging relative distances between objects, or between oneself and objects (Kranowitz, C. 2003).

A young infant first has to maintain head control before learning to control the rest of the body. Growth proceeds from general to specific, gross to refined, cephalocaudal (head to tail) and proximo-distal (near to far). The infant, in learning to control balance, follows all of these premises (Welsh & Blasch, 1980).

A prerequisite to movement is balance. This is defined as an ability to maintain or assume any body position against the force of gravity (Mosston, 1965). Posture becomes the basic guide from which all other movement patterns develop. The center of gravity in one's posture is the point from which direction, space orientation, and movement must originate. Only when the child has determined the line, direction, and force of gravity can the child proceed to the development of the coordinates of space around him (Chaney & Kephart, 1968). Posture may either be static or dynamic (Gessel, et al). Static posture is the body's ability to produce steadiness and stance, and includes muscle tone and balance. Dynamic posture relates to locomotion, prehension (the perception by the senses of sight, sound, smell, taste or texture), and inspection, and relates to movement or an act of changing position.

Equilibrium is an aspect of posture. Equilibrium relates to a physical state or sense of being able to maintain bodily balance and a mental state of calmness and composure. Broer (1979) lists a number of principles of equilibrium.

- The larger the base, the more stable the body.
- The nearer to the center of the base of support the line of gravity falls, the more stable the body.
- To increase the stability of the body when moving, the base must be enlarged but this must be done so the joint movement is not restricted or strained.
- The center of gravity shifts with movement, but the lower this center of gravity, the more stable the body.
- The force of gravity must always be considered when a person is moving and equilibrium is developing.

The interest in psychomotor development has resulted in a number of theories and training concepts dating back to Jean Piaget who believed sensori-motor development is the basis for all learning to Jean Ayers the founder of the theory of sensory integration therapy. Ayer, an occupational therapist, contends that integrated processing results in perception and that the ability to synthesize these data helps the individual to interact efficiently with the environment (Ayers, 1961). Thus, gravitational insecurity results from poor processing of vestibular and proprioceptive stimuli and can cause acute anxiety, fear or panic.

Sensory Integration Therapy (SI)

Sensory Processing Disorder is a neurological disorder causing difficulties with processing information from the five classic senses as stated earlier (vision, auditory, touch, olfaction, and taste), the sense of movement (vestibular system), and/or the positional sense (proprioception). SI Therapy practice is recognizing and treating unique sensory symptoms that are not explained by other known disorders. Treatment is a fun and play-based intervention. Private clinics and practices, hospital outpatient departments, and university occupational therapy programs are typical places where treatment for SPD or for sensory issues in other disorders such as ADHD and Autism can be found. Children are most commonly treated for SPD with occupational therapy (OT) (spdfoundation.net).

Therapy practices are developed based on the child's dysfunctions. These include:

1. **Sensory Modulation Dysfunction** – These children cannot properly regulate their sensory input. The child may over-react or under-react to sensory situations. Hypersensitive children may react intensely to a stimulus and will avoid sensory situations. They may present as unenthusiastic or disobedient. Hyposensitive children may under react and seek out stimuli. These children are often seen as hyperactive but also may be difficult to stimulate.
2. **Dysfunction in Sensory Discrimination** – These children have a central nervous system that inaccurately processes sensations, with the result that they cannot use the information to make purposeful, adaptive responses and get on with day-to-day activities (Kranowitz, 2003).
3. **Dyspraxia**- Many times this is defined as poor coordination. Dyspraxia is described as having two main elements: Ideational dyspraxia which is the difficulty planning a sequence of coordinated movements and, Ideo-Motor dyspraxia, difficulty with executing a plan even though it is known.

Each of these has separate and common therapy modalities. One theme common to these modalities is proprioception. Proprioceptive activities can include the use of weights, weighted products, jumping, bouncing, rocking, pushing, pulling, swinging and being tightly swaddled.

The Use of a Weighted Vest

Weighted Vests are often used in a therapy plan for children with SPD. Double-blind, placebo controlled research in this area is non-existent. The concept of a weighted vest is based on the SI technique of deep pressure. Deep pressure is often used to assist the child to self-calm and relax so that sensory stimuli can be processed. Deep pressure vests should not be confused with a weighted vest, although a weighted vest uses deep pressure. A deep pressure vest is specific for applying pressure at one specific body part.

The use of a weighted vest provides the child with unconscious information from the muscles and joints. Children who are easily distracted, hyperactive and lacking in concentration can respond positively to the additional weight a vest provides. Weighted Vests are thought to provide proprioceptive input and deep pressure through the addition of weight to the body in the hopes that this will give the child's body enough delay time in their thought process to calm and make logical sense of their environment.

The Basis for the Development of the In Your Pocket® Weighted Vest©

In 1998 my son James was diagnosed with Pervasive Developmental Disorder (PPD) and he began multiple therapies to assist in all areas of his development. During OT our wonderful therapist Pat dressed James in a primitive garment with sandbags to assist with his SI. She explained to us that this would help him self- calm and become more focused on the tasks we were attempting to do. The vest worked. Not only did it work in his therapies, it also worked at home, at the grocery store, at church, and for most transitions. However the vest we were using made James issues more noticeable. At that time I researched weighted vests that were on the market and only found a few, most of which were very “therapeutic”/Institutionalized in appearance. As a nurse for over 21 years with a Masters Degree in Maternal- Child Nursing, I knew there was a better way. My first goal was to create a safe product; second to design a weighted vest to visually blend into a child’s world; thirdly to design a vest that worked in day-to-day “reality” for the family routine not just therapy and finally to share my knowledge with others. In addition, I discovered and designed a way to make weights using a non-toxic, non-drying modeling.

Before making the In Your Pocket® Weighted Vest© many variables were researched to make a multifunctional garment. First, the relationship of body to the senses was researched. As noted previously only when the child has determined the line, direction, and force of gravity can the child proceed to the development of the coordinates of space around him (Chaney & Kephart, 1968).

Second, began the research of the physical characteristics of children. According to the report PHYSICAL CHARACTERISTICS OF CHILDREN AS RELATED TO DEATH & INJURY FOR CONSUMER PRODUCT SAFETY DESIGN (FDA, 1975), which sampled three thousand children, infant and child anthropometric data should be taken into consideration when developing all products for use with children. These data are not limited to products but also are necessary for transportation issues such as car seats. It is clear by research those important factors such as, gravity, posture, body control and equilibrium should be included when designing clothing for children;

especially when adding weight to the body which can disrupt or alter the parameters reviewed in this paper. Another consideration for safety was to use non-toxic, non-drying modeling clay for the weighted material. This weight technique conformed to the child's body as the vest was worn. The stability of the weights enhanced the child's proprioceptive sense.

The two significant anthropometric data from the above research for the In Your Pocket® Weighted Vest© design were gravity sitting height and the gravity standing measurements. The study method and data results are described below.

Standard anthropometry was used to determine each measurement. The crown-rump (sitting) measurement was the perpendicular distance from seat to vertex. The data compiled used the mean of the crown-rump measurements. The center of gravity while seated was determined to be approximately 5 inches above the seat. Approximately 50% of the subject's measurements were the same for the age of the child. The In Your Pocket® Weighted Vest© uses this measurement to determine the placement of the weights while the child is seated.

Gravity Sitting Height Measurements

Age	Crown –Rump Measurement Mean length in inches	Seated Center of Gravity % Mean of Subjects
Age 2-3	11.5	48.9%
Age 4 -6	16.7	46.9%
Age 7-9	17.6	46.6%
Age 10-12	18.4	45.2 %

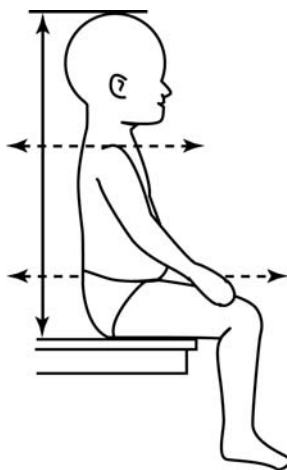


Figure 1. The dotted line represents the mean length of gravity sitting measurement roughly 4-5 inches from rump. (Drawn by Mary Layman)

The gravity standing measurement was the perpendicular distance from the floor to vertex. The data compiled used the mean of the crown-sole measurements. The center of gravity while standing was determined to be approximately at the

child's natural waistline or navel. Approximately 60% of the subject's measurements were the same for the age of the child. The In Your Pocket® Weighted Vest© uses this measurement to determine the placement of the weights while the child is standing.

Gravity Standing Measurements

Age	Floor to Vertex Measurement Mean length in inches	Standing Center of Gravity % Mean
Age 2-3	21	58.9%
Age 4-6	25.4	58.5%
Age 7-9	27	58.0 %
Age 10-12	28.7	58.3%

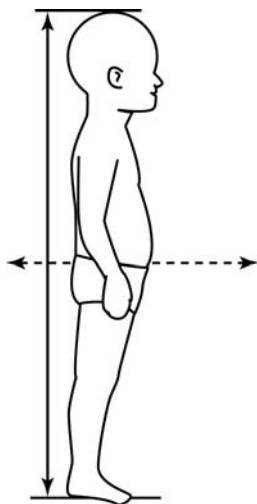


Figure. 2. The dotted lines represents the mean length of gravity standing measurement. (Drawn by Mary Layman)

The report DETERMINING CENTERS OF GRAVITY OF CHILDREN SITTING AND STANDING (Swearingen, J; Young, J, 1965) which studied approximately 1,200 children (ages 5 to 18) was cross referenced for data accuracy. It also demonstrated the center of gravity mean for small children sitting to be located roughly 5 inches above the seat.

The In Your Pocket® Weighted Vest© design sizes were determined using National Health and Nutrition Data Growth charts (NCHS, 1975). The hallmark feature of the design uses the principle of gravity on the body, i.e., the gravity sitting height and the gravity standing measurements. These design measurements maintain the center of gravity around the child's body, allow for comfort while seated and also; keeps deep pressure on the shoulders from the continual downward weight of the vest toward the center of gravity. Other design features were based on proprioception, the vestibular system, motor planning and maintaining posture while using the concept of deep pressure.

Overlay of The In Your Pocket® Weighted Vest© based on Anthropometric Data.

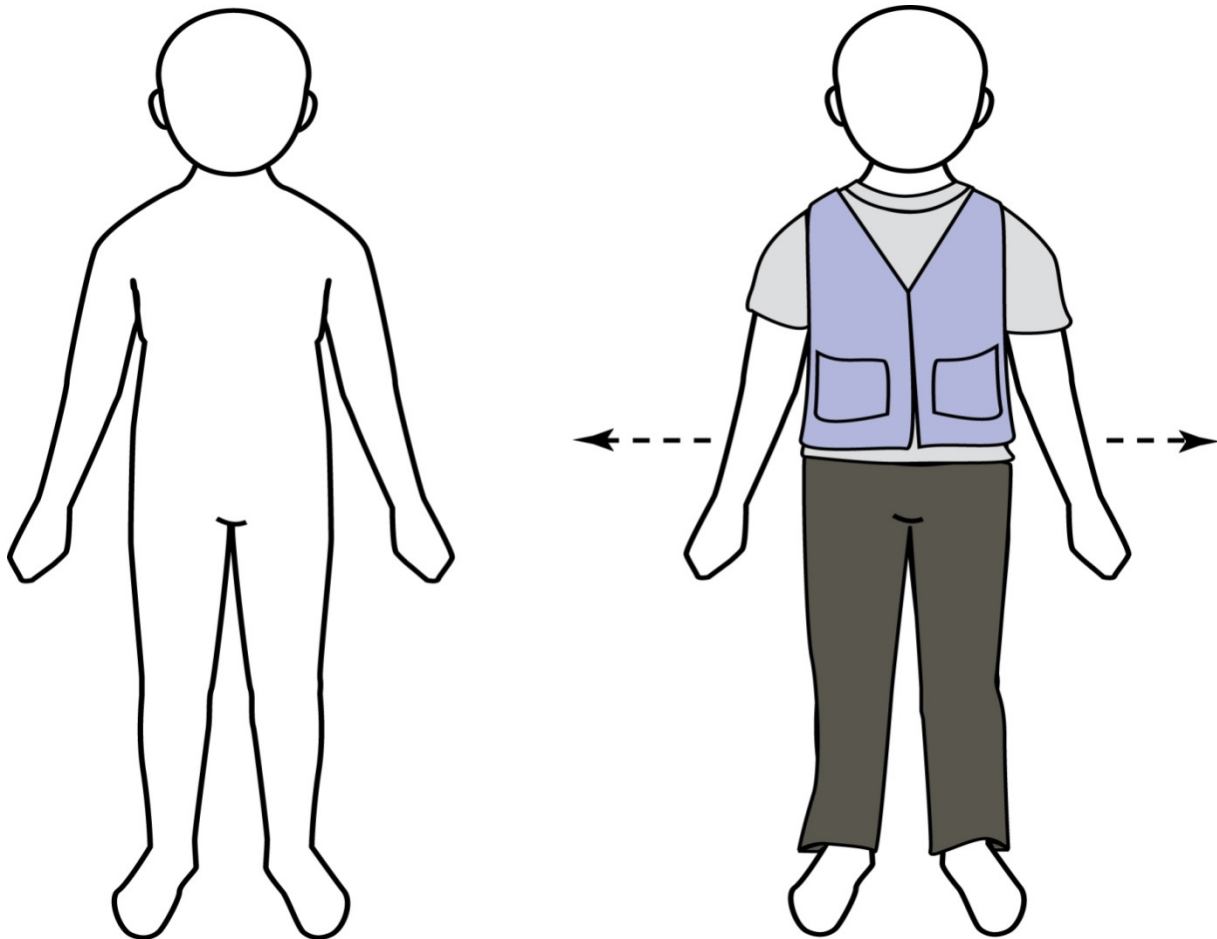


Figure. 3. The drawing shows a superimposed representation of the In Your Pocket® Weighted Vest© center of gravity placement of weights.

Design Features of the In Your Pocket® Weighted Vest©

Proprioception and the Vestibular System Features

The In Your Pocket® Weighted Vest© works with the position sense through body awareness and the sense of touch. Even when the child is motionless, gravity stimulates the receptors to create proprioceptive messages without our being consciously aware of them (Kranowitz, C. 2003). The weights in the In Your Pocket® Weighted Vest© are evenly distributed around the body; they touch the body and help the child become aware of their body and its movements. Because the total amount of weight around the body is even and static, the vest can aid the vestibular system in providing the connection between balance, movement and gravity. This creates the environment for the child to move effectively throughout their day

Motor Planning Design Features

The In Your Pocket® Weighted Vest© creates an environment for the child's body to delay their thought process through added weight. This process allows for the ability to make logical sense of a task, activity or movement. All tasks are either in fine or gross motor planning. This process of added weight has been demonstrated by researchers although with limited subjects. The most consistent improvement observed in these studies was the decrease number of distractions and self-stimulatory behaviors.

Motor planning also relates to the neurological process of bilateral integration. This is the process of integrating sensations from both sides of the body and is the basis for bilateral dexterity. The In Your Pocket® Weighted Vest© evenly distributes its weight so that all planes of the body receive the same sensations.

Maintaining Posture Features

As the child begins to integrate senses the child learns to control movements. A prerequisite to movement is balance and can be defined as an ability to maintain or assume any body position against the force of gravity hence; posture becomes the basic guide for movement. The center of gravity is necessary for posture from which direction, space orientation, and movement originate.

In addition, recommendations for backpack safety from many professional organizations including the American Academy of Pediatrics, the Consumer Product Safety Commission and the American Occupational Therapy caution against wearing backpacks incorrectly due to improper weight (no more than 10-15% of the child's body weight) and increased risk for musculoskeletal injuries. "Injury can occur when a child, in trying to adapt to a heavy load uses faulty posture such as arching the back, bending forward, twisting, or leaning to one side" (apta.org). The American Physical Therapy Associations also recommends that the backpack rest evenly in the middle of the back near the child's center of gravity (apta.org). The addition of weight to the body changes posture. Anecdotally, most therapist recommend weighting a vest with no more than 10-15% of the child's body weight

The In Your Pocket® Weighted Vest© evenly distributes the weight around the body so that the demand of the weight in the vest is equal bilaterally. Also, the weights are placed close to the

body for minimal movement to decrease postural shifts. The center of gravity is important for carrying weight and as previously discussed is a hallmark feature in the design.

Deep Pressure Features

While the In Your Pocket® Weighted Vest© design uses the concept of deep pressure by providing additional weight to the body for proprioception, it must not be confused with a “Deep Pressure” vest. Deep pressure vests apply weight to one body part such as the shoulder or entire chest. The In Your Pocket® Weighted Vest© provides deep pressure to the shoulders, ligaments, tendons and muscles depending on the position or activity in which the child is participating. The other design features carry the vest for many uses other than for deep pressure alone. These include maintaining the child’s dignity when wearing the vest, and using the vest as a tool for the family when away from therapy for daily activities of living (transitioning, providing calming in grocery stores, church, etc.).

CONCLUSION

To the author’s knowledge, the In Your Pocket® Weighted Vest© is the only clothing product for Sensory Integration practices that has been designed with the prerequisites of growth and development standards, anthropometric data, safety data and the daily living activities of children and their family. The design of the In Your Pocket® Weighted Vest© also looks like regular clothing while providing the principles of gravity, posture, body control and proprioception. This multifunctional vest is an excellent vest for therapy and will work in the day-to-day “reality” for the family and child’s routine. The In Your Pocket® Weighted Vest© provides the regular look of clothing while preserving the child’s dignity, the compliance of treatment plans as well as enhancing the child’s sense of well-being.

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