

The Forgotten Sense – Proprioception

This is first in a series of articles by David Brown, Education Specialist with California Deaf-Blind Services, exploring the part that the less well-known senses play in our development and the lives we lead

Introduction

There is still much that we don't understand about early brain development, about the development of sensory processing abilities, about the way we develop the ability to use all our senses simultaneously without confusion, and about the complex interaction of these abilities with personality type, and with early life experiences. When we consider these issues for children with deafblindness our knowledge is even more limited; the population is extremely diverse in terms of ability and disability, and increasingly we see children who demonstrate difficulties with all sensory systems, not just with vision and hearing but also with the 'other' senses – the touch, taste, smell, proprioceptive, and vestibular senses. Apart from some work on touch there has been very little research to look at any of these 'other' senses in this diverse group of children, but we do know from experience that difficulties with vestibular and proprioceptive functioning, in particular, always need to be addressed first if the children are to make the best possible progress in using touch and residual vision and hearing effectively. Knowing

about these 'other' (I would say 'forgotten') senses will give you a different way of looking at yourselves and at other people, and should also help to make children with deafblindness less puzzling in their behaviors.

In the field of deafblind education we have traditionally, and for obvious reasons, focused on the senses of vision and hearing and on strategies for improving the use of any residual function that may be present in both of these distance senses. At the same time we have also, as I have said, paid some attention to the sense of touch as an important information channel that can help to compensate for loss of visual and auditory information. The other sensory systems, the taste, smell, proprioceptive, and vestibular senses, have received very little attention from us, even though together they provide the essential foundation upon which all of our higher vision, hearing, and touch skills are based. These other sensory systems also offer valuable channels to the children for learning and to us for teaching. In the field of occupational therapy, physical therapy, and speech therapy the situation is quite the reverse. Therapists have long been trained and skilled

in assessing and working on these other sensory systems, yet they traditionally receive no training at all in deafblindness, so we would all benefit from a two-way exchange between educationalists and therapists to share our knowledge bases that are complementary yet rarely meet. Consideration of all the sensory systems, and the ways that they work together, can help us to be more effective in our educational assessments and in our teaching, and can clarify that complex situation whereby:

"The brain, the organ that is responsible for your conscious experience, is an eternal prisoner in the solitary confinement of the skull...and must rely on information smuggled into it from the senses...the world is what your brain tells you it is, and the limitations of your senses set the boundaries of your conscious experience."
*Coren, Porac & Ward
Sensation and perception
(1984, p2)*

These topics are usually considered to be the specialist area of physical therapists and occupational therapists, but as a teacher I have been studying them for three decades in the context



In order to use her residual vision to look at fine details in a book Amy needs to be horizontal with her entire body and head fully supported: having one ankle up on the other knee sends her brain a strong message, through the proprioceptive sense, that her lower body is fixed and stable and not moving."

of working with a large and varied population of children with deafblindness, so this is definitely a teacher's perspective. These topics are also very complicated, and although I have tried to simplify the material there are certain jargon words and phrases that have to be used; knowledge of this vocabulary is important because the specialized words and phrases are likely to come up in medical and therapy reports on the children with whom you live and/or work.

The sense of Proprioception

The way we can 'feel' where all our body parts are in relation to each other (and

also 'see' them in our mind's eye), without actually having to touch them with a hand or look at them with our eyes, is an ability that we get from our proprioceptive sense. This sense helps us to plan, to position, and to grade our movements without always having to use vision to check what we are doing. You can feel this sense working if you close your eyes and place your right index finger on your nose, and then touch the same finger on to the tip of your left thumb; the proprioceptive sense is not infallible so you may miss your targets a little, but with repeated practice your aim will improve significantly (which reminds us that proprioceptive abilities can be

learned through experience and improved through practice). Proprioception is a strange word, actually a combination of two Latin words that means 'an awareness, or a feeling, of one's own self'. Most people have never heard of this sense, and when they use the single word 'touch' they are usually thinking about several different sensory systems, including proprioception as well as perception of touch, pain, temperature, and vibration. In fact touch is a system that provides us with so many different forms of information, with so many complex and contradictory elements, that some writers have said it may actually be misleading

Nick is seeking strong proprioceptive information to help him know where his body is - strong pressure from the swing on his stomach, upper and lower body stretching undergravity, and both arms inside his tee shirt for extra pressure.



to speak of a distinct 'sense of touch'. Other writers have claimed that proprioception is actually a specialized variation of the sense of touch that encompasses the sensations of joint motion (known as kinesthesia) and the sensations of joint position (known as joint position sense). As I talk about proprioception you will notice how often I mention the sense of touch as well, since they operate together so closely.

The proprioceptors

The receptors of the proprioceptive sense (which are known as the proprioceptors) are located in the muscles and joints throughout the body, and they are sensitive to stretching and to compression. When this sense is working effectively the brain, at all times, has an awareness of where the various body parts are in space, if they are moving or not, and how fast and in what direction they are moving. This constant 'running' awareness is conveyed to the brain depending upon which proprioceptors are being stretched or compressed, and

the force applied, and the direction of the stretching or compression, and also depending upon the angle of every joint. We talk about this sense enabling us to 'feel' where our body parts are, but this does not mean 'feeling' like 'touching' one body part with another – it is an entirely internal sensation.

Why does it go wrong, and what happens when it does?

A normal range of muscle tone is needed for this sensory system to work efficiently and effectively, so anything that causes abnormal muscle tone will interfere with the effective working of the proprioceptors. Injury, surgery, arthritis, cerebral palsy and other kinds of brain damage, poor circulation, and poorly modulated muscle tone (that is, muscles which are too stiff or too floppy, or which can only alternate between these two extremes) can all result in diminished proprioceptive perception and awareness. Problems with the proprioceptive sense can be made worse when there are also difficulties with the vestibular sense, and with the tactile and

visual senses, all challenges that are very common in the population of children with deaf-blindness. We have all experienced temporary loss of proprioceptive perception when a leg 'goes to sleep' after we have been sitting for a while with it folded beneath us, with the result that the blood circulation to the leg has been cut off; for a brief period we can't 'feel' the leg or the foot at all and it is very difficult to stand and bear weight on it because the ankle and the knee refuse to lock and remain stable for us. We use a variety of behaviors like shaking the leg, rubbing it firmly with our hands, patting it hard with the hands, or trying to stamp the foot on the floor – and all of these are strong proprioceptive stimuli – in order to restore normal sensation and function as quickly as possible.

When a child has a proprioceptive sense that is not working properly some common outcomes may be:

- An inability or a reluctance to push up on the hands and arms when laying face down due to low muscle tone and an inability to 'feel' and control the joints in the fingers, the wrists, the elbows, and the shoulders.
- An inability or reluctance to stand and bear weight due to low muscle tone and an inability to 'feel' and control the joints in the toes, the ankles, the knees, and the hips, while also maintaining vertical stability in the spine.
- Frequent use of the arms and hands to prop the head or the upper body,

or frequently needing to lean against furniture, walls, posts, trees, or other people.

- Heavy foot stamping, sometimes several times with each step, when learning to walk – literally ‘feeling the feet’ through a combination of tactile sensation and, especially, this strong proprioceptive input.
- Paradoxically, after months or years of forceful flat foot slapping on the floor while independent walking is developing, some children, once walking is mastered, develop and prefer a tip-toe barefoot style, the bare feet maximizing tactile sensation, and being on tip-toe maximizing the proprioceptive (pressure) input through the feet, the ankles, the calves, the knees, the thighs, and the buttocks - a different way of ‘feeling’ the muscles in the legs and the feet by tightening them up so that the brain knows exactly where they are and what they are doing.
- Clumsy, poorly coordinated movements, so that sometimes the child must make several attempts to achieve the desired outcome. Children may use specific self-taught strategies to minimize errors, such as close visual scrutiny, or sliding the hand or arm along a wall or a table in order to reach for an object, which provides tactile information about their movements and helps to stabilize the arm, as they reach.
- Use of too little force, or of excessive force (poorly

graded movements), when touching, patting, grasping, pushing and pulling, and lifting or placing things. The child may adopt abnormally high muscle tone, use strong movements, an over-firm grip, and excessive force in making contact with people or objects, all of which may be mis-interpreted as aggressive, rough, clumsy, or inattentive by others.

- Seeking strong pressure or stretching inputs. Examples would include squeezing into tight spaces like a cardboard box or under a chair, crossing or twisting limbs around each other, binding body parts with cloth or string or rubber bands, pulling the teeth and lower jaw downwards, grinding the teeth, tapping things on the teeth, banging on the face or head, clapping or flapping the hands, swinging the legs through space while seated, hanging doubled over a bar or swinging from it by the arms, jumping up and down with the ankle and knee joints as locked as possible, hammering an object on the floor or on a table, kicking heavy objects like furniture or doors).

Excessively high or low muscle tone is usually associated with poorly modulated tactile and proprioceptive senses in these children, tactile defensiveness may be present, and awareness of touch, pain, and temperature may be poor, or fluctuating.

Children often adopt specific postures (for example, flat on the back with both legs bent and

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one ankle up resting on the other knee, or the legs tightly crossed, or the legs twisted around the chair leg, or the fingers crossed or bunched together, or the hands tightly fisted, or the arms folded in front of or behind the body). These postures provide essential extra tactile and proprioceptive information to the brain about where the child’s limbs are in space, and they also confirm for the child that their body is securely ‘fixed’ and not moving or floating around.

What can we do to help?

- Consultation with an occupational therapist (preferably trained in Sensory Integration Therapy) and a physical therapist, sharing any observations you have made of the kinds of behaviors mentioned above. As well as specific therapy suggestions the therapists may have ideas on environmental adaptations that will facilitate better control of movements, or ideas to make it easier for the child to succeed at a range of appropriate motor activities (for example, simplified equipment, simplified task, providing extra physical supports, providing a heavier spoon or baseball

bat or pen as appropriate to increase proprioceptive sensation, or using clearer visual markers).

- Consult with an Adapted Physical Education teacher for older school-aged children, share any observations you have made of the kinds of behaviors mentioned above, and implement the specialist's suggestions.
- Deep pressure massage, brushing protocols, and rhythmic joint compression. These might be part of a specific Sensory Integration Therapy program, or they could be considered more as part of a conversational activity between you and the child. Rhythmic joint compression and stretching of fingers, arms, legs, or the head and neck can be extremely motivating for children with this type of sensory difficulty and might be a useful strategy to help you to build a relationship with a child who is avoiding social contact. They can also help to 'wake up' the proprioceptive system for a period of time, which may facilitate better perception and performance in specific activities.
- Use weighted clothing, a weighted cloth across the lap when sitting, heavier shoes, heavier bed covers when sleeping, as appropriate. The young man you saw hanging over the swing in the photograph has learned the helpfulness of increased pressure sensation, and often likes to get both his arms inside his shirt so that it presses tightly around his body.
- Binding of whole body parts or specific joints, for example using a blanket, or tight gloves, Lycra sleeves or Lycra clothing. Bracing and wrapping have been used with adults with proprioceptive problems following illness, injury or surgery, and this is reported to serve a sensory function in addition to a mechanical function. For example, an elastic bandage has been known to enhance joint position sense in patients with osteoarthritic knees as well as in patients after significant knee surgery.
- Sports coaching programs and sports injury clinics use proprioceptive training ideas a lot, and it is also a major component of the Alexander Technique and other related disciplines, and learning a little about these might trigger some relevant ideas.
- Chewing gum or 'chewy' items that stimulate strong proprioceptive input through the jaw can be rewarding for these children, and can result in better regulation of arousal levels for calming and attending, and in improved attention span, so better functioning of other sensory systems too.
- Other ideas would include hydrotherapy or water-play (immersion in water increases pressure all over the submerged parts of the body and reduces the challenging impact of gravity), horse riding, a crash mat, a whole range of acceptable 'rough & tumble' play, a climbing frame to swing from, and a trampoline. Because

diminished proprioceptive feedback enhances the risk of injury it is always a good idea to seek professional help and guidance with any of these large movement/strong input activities, and to ensure that there is always an appropriate level of adult monitoring and supervision.

As with any sensory deficit, poor proprioceptive functioning can be difficult to identify and assess, particularly when it is only a part of a wider pattern of sensory and other impairments. However, like the other 'forgotten sense', the vestibular, it is crucially important to all areas of functioning, so proprioceptive abilities and challenges need to be assessed carefully for any child with deaf-blindness. The pressure that they feel needs to be primarily through their proprioceptors, rather than from people in their lives who look at them and can only jump to quick conclusions and think in terms like 'clumsy', 'aggressive', 'mean', and 'lazy'.

This article has been developed from "Feeling the Pressure" published in CDDBS newsletter reSources.

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