A Multi-disciplinary Approach to Sensory Integrative (SI) Dysfunction – A Case Study

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Abstract

The presentation begins by describing the sensory pathways, the process of sensory integration and sensory integrative dysfunction. It goes on to introduce Sensory Integration (SI) theory and SI therapy. It discusses how they are both being increasingly applied to interpret and treat the maladaptive behaviours often displayed by people who have a developmental disability.

The presentation considers the link between music therapy and Sensory Integration theory before concluding with an individual case study. The client has sensory integrative dysfunctions. The presentation describes and then presents a quantitative evaluation of a multi-disciplinary treatment programme that comprised an individual music therapy session and a movement session. The presentation examines the results of the evaluation and discusses the issues it raises in relation to music therapy with people who have a developmental disability.

Sensory pathways and sensory integration and sensory integrative dysfunction

More than 80% of the activities of the nervous system involve processing and organising sensory information (Berger 2002). Sensory information is collected by receptors found in the special sense organs -the retina in the eyes, the balance organs and cochleas in the inner ear, and the taste buds in the tongue, as well as throughout the body in muscles and joints, the internal organs and the skin. The receptors are attuned to a particular stimulus - for example, a particular
wavelength of light or a vibration of sound, and they fire when excited. When a receptor fires a signal is passed along a nerve fibre.

The brain stem and thalamus are the principle sensory pathways into the sensory cortex of the brain. The brainstem is a highway for sensory signals. The thalamus sits at the top of the brainstem. It acts as a filter and selects information from the mass of sensory signals.
Information that passes to the sensory cortex of the brain via the brainstem and/or the thalamus is consciously perceived.

Sensory information is also processed in the cerebellum. The cerebellum is located behind the brainstem. Information processed in the cerebellum does not lead to conscious

sensation.

Sensory information from the eyes passes to the sensory cortex of the brain through the thalamus alone and is consciously perceived as sight. Visual processing functions (e.g. visual discrimination, visual attention and visual memory) contribute to visual perception and allow us interpret and use what is seen. The visual system supports vestibular and proprioceptive systems that will be considered later.

The following sensory information is also consciously perceived as it passes through the brainstem and the thalamus. Information from the inner ear contributes to hearing - the auditory sense. While the tactile sense receives sensory information from the internal organs and the receptors throughout the skin, and the sense of taste receives sensory information from taste buds located primarily on the tongue, palate and the floor of the mouth.

The auditory system is perhaps the most intricate of all the sensory systems. The ability to understand what is heard (auditory perception) involves more than the sense of hearing. Hearing is the passive act of receiving sound - an involuntary physiological response. Auditory perception, or listening, is a voluntary activity that is learned by repetition and, along with visual perception, auditory perception takes place at a higher cortical level. It depends on the ability to discriminate between sounds (auditory discrimination), to associate and decode sounds (auditory acuity, sound localisation, auditory figure-ground) and to remember what is heard (auditory memory).

The tactile sense, the first to develop in utero, is the most mature at birth. Infants learn about their body and the environment through tactile exploration. Tactile receptors are activated by touch, pressure, pain and temperature and two tactile systems - the discriminatory and protective - work together. The discriminatory system transmits information about where the body is touched and the conditions of the environment. The protective system is alerted by the brain to potentially dangerous touch sensations. In this way information from the tactile system plays an important role in perceiving the environment and in developing protective reactions for survival.

The final two sensory systems the vestibular and the proprioceptive are perhaps less familiar.

Information from three sources - the eyes, muscle and joint receptors and three receptors, hair cells called cristae, located in the semicircular canals of the ears - enables the vestibular system to inform the brain about the orientation of the head and body and interpret the speed and direction in which the body is moving in space. This information is processed in the cerebellum and does not lead to a conscious sensation. Nevertheless, it monitors and maintains our balance against gravity and ensures that when we visit the famous Italian landmark The Leaning Tower of Pisa we realise that it is the Tower and not ourselves which is doing the leaning. While, as a train pulls away from the platform, it is the vestibular system that informs us that it is the external environment and not our body that is moving.

The proprioceptive system collects information about the state of contraction of the body's muscles from muscle and joint receptors and information about its position relative to the outside world from the balance organs in the inner ear. The information passes via the brain stem and thalamus and is perceived as sensations, which modulate movement activities. As a soccer player prepares to take a penalty kick the muscle and joint receptors send signals to the brain letting it know where the limbs are, what they are doing, and where the body is in space. The player draws on previous experience of the activity - something often referred to as "memory of sensation" - and completes the correct series of movements. The amount of knee bend, the force of contact between ball and foot and the distance of the follow through after striking the ball, have all been perfected through practice and are all required to execute a successful penalty kick and score a goal. The visual system plays its part too as the player looks from the ball he is striking to the intended target - the goal.

Clearly the sensory systems do not work independently of each other. The proprioceptive and tactile systems combine to convey information about the state of the body and its immediate environment. This sensory activity that originates from somewhere other than the special sense organs is usually referred to as a somatosensory perception. The vestibular and auditory systems are linked anatomically by the vestibulocochlear nerve. This nerve, located in the inner ear, consists of two parts - the vestibular nerve and the cochlear nerve. The vestibular nerve carries sensory impulses to the cerebellum which, in conjunction with information from the eyes and joints, controls balance. The cochlear nerve conducts sensory impulses from the cochlea to the hearing centre in the brain, where the impulses are interpreted as sounds. In addition to this anatomical link, the vestibular and proprioceptive systems, relying as they both do on information from muscle and joint receptors, work in tandem with one another.

So the next time you hold a red apple, consider the tactile, proprioceptive, and visual information that is passed to the brain, which distinguishes this item from a much heavier red cricket ball, and informs the hand of the appropriate position and energy required to hold on to this item.

The soccer player taking the penalty and the act of holding on to a red apple are both examples of an innate neurobiological process know as sensory integration. Sensory integration is the brain's ability to take in information through the senses about our bodies and the environment (input); to sort and screen that information (integration); to put it together with information, memories and knowledge already stored in the brain and to respond to it in a meaningful way (interpretation).

In normal development, sensory integration takes place from infancy through childhood in a natural order that follows the same basic sequence. For example, it takes the human brain and physical system 9 to 18 months to learn to walk. A child is well integrated by 8 to 10 years and sensory processing then continues to be refined through life.

SI dysfunction may result from an inability to register, modulate or discriminate different

sensory inputs. Each problem is specific to a single stage of the process describedearlier. Each problem causes learning to be impaired.

A person who does not register information correctly and who has a deficient orienting response is paying little attention to sensory input and disregarding new stimuli. The orienting response is the mechanism through which the nervous system detects a novel stimulus by mismatching it with those already stored in an individual's memory. As a result of deficits in sensory registration and the orienting response a person fails to look, listen, process and remember.

Sensory modulation refers to the capacity of the nervous system to process sensory signals by filtering and inhibiting non-essential incoming information. Sensory modulation problems occur at the integration stage of the process. A person may either over-react to a stimulus (hyper-reactivity) - in this case they cannot inhibit messages to reduce irrelevant activity; or they may under-react to a stimulus (hypo-reactivity) - in this instance they cannot facilitate some messages to maximise a response. They have a nervous system which is either highly aroused or which fails to notice or responds slowly to sensory inputs. A highly aroused nervous system prepares the body for survival and places it in a constant fight and flight state. A person with a highly aroused nervous system does not recognise that an input is non-threatening. He or she, placed in a state of anxiety, develops habits and patterns of behaviour which avoid sensory events or which seek sensations that may restore comfort. This is usually referred to as sensory defensiveness - an umbrella term used to cover insecurity in each sensory system. In contrast, sensory dormancy is a diminished responsiveness to sensory inputs. A person with sensory dormancy will lack interest in some sensorimotor activities or once involved in an activity will tend to perseverate.

Sensory discrimination problems arise when a person experiences difficulty interpreting the filtered information and responding appropriately to what is going on. A person with sensory discrimination difficulties does not have a good awareness of their bodies from their sense of touch or from their muscles and joints and they have little or no interest in purposeful or constructive activities. Consequently, they experience problems in development, information processing and behaviour.

All of us depend on sensory integration to carry out daily tasks in play, work and self-maintenance and ultimately to survive. It is through our senses that we adapt to situations. In this way we meet our need to survive on an instinctive sub-cortical level, and we meet our cortical survival needs - the need for self-determination and spiritual fulfilment. It is through this process of functional adaptation that we instinctively adapt to short-term alterations of environmental conditions - we shiver in cold weather to maintain a constant body temperature (immediate reflexive response). It is through functional adaptation that we make a permanent adaptation to a persistent stimulus - this is what is happening as we develop any particular skill (delayed conditioned response); and through continuous disturbances over centuries that genetic adaptation occurs (permanent encoded response).

Sensory Integration (SI) theory

Sensory Integration (SI) theory has been influencing the field of Occupational Therapy for over 40 years (Spitzer, Roley et al. 1996). It was developed by Dr. A. Jean Ayres. Ayres combined studies of brain function with years of experience treating children who had specific learning and motor organisational difficulties that could not be attributed to abnormalities in the central nervous system (Fisher, Murray & Bundy 1991). She found that the bodies and brains of these children did not process sensations efficiently to produce normal organised learning, movement control and behaviour. However, SI theory was not intended to explain learning difficulties and neuromotor deficits associated with cerebral palsy, Down's syndrome and strokes (Fisher, Murray & Bundy 1991). Ayres went on to develop SI theory and over 20 standardised neurophysical tests for diagnosing SI dysfunction (Spitzer, Roley et al. 1996).

SI theory was proposed in the 1960's and, along with other underlying skills models developed at that time, it was based on the hierarchical integration of information on the brain. Kephart developed perceptual motor theory; Barsch moviogenic theory and Osgood psycholinguistic schema (Gfeller 1984). Ayres, for her part, suggested that higher level cortical skills - perception, reasoning, language and learning were dependent on the filtering and integration of sensory inputs at lower sub-cortical and brainstem levels (Mauer 1999). An integrated sensory system was regarded as the building block that laid the foundation for skills on each of the higher levels (Chu & Green 1998). It was only when the body was comfortable with incoming sensory information, and no longer feeling threatened by it, that the brain could process information at a higher cognitive level (Berger 2002). Ayres did not use the term sensory integration just to refer to neural connections. She believed that a link existed between sensory integration and a person's occupational behaviour. She reasoned that sensory integration contributed to a person's functional behaviour and, in developing SI therapy, defined sensory integration as "the organisation of sense for use" (Spitzer, Roley et al. 1996).

SI therapy is carried out in a secure, comfortable environment and one in which each client feels safe to explore all the possibilities offered to them. SI sessions provide sensory activities that offer vestibular, proprioceptive and tactile stimulation and promote sensory integration (e.g. using a hammock, trampoline, bubble ball pool or vibration cushion). The motor component of each is regarded as especially valuable as it provides the necessary sensory input to encourage sensory integration (Chu & Green 1998).

The sensory input of each activity is carefully planned and controlled. The therapist begins by identifying the main sensory input provided by an activity (e.g. using a hammock stimulates the vestibular system). The therapist before using the hammock identifies the client's underlying sensory modulation dysfunctions (e.g. the client may have a hyper-reactive vestibular system). The sensory input from the hammock is carefully controlled to either slow down a hyper-reactive system (inhibit) or stimulate (facilitate) a hypo-reactive system. The hammock can be moved in a gentle rhythmical way to inhibit sensory input, while fast and irregular movements facilitate the sensory

system. The therapist aims to elicit an organised response (e.g. maintaining a swinging motion) in conjunction with the controlled sensory environment or in a daily living activity carried out after SI therapy. The therapist believes that a successful response depends on achieving a "sensory diet" (Wilbarger & Wilbarger 1991) which mixes facilitation and inhibition techniques and creates a perfectly balanced state in which the client is neither too highly alert or too relaxed to pay attention (Chu & Green 1998).

SI therapy does not train specific skills or behaviour. The client is not drilled or instructed how to respond and sessions are as unique as the individual for whom they are developed (Stonefelt & Stein 1998). The therapist directs the environment, uses the client's natural reactions, and encourages him or her to respond to sensory input in a more successful, organised and functional way. By eliciting an adaptive response in this way SI therapy improves the efficiency with which the central nervous system interprets and uses sensory information; it enhances the brain's ability to perceive and remember and it assists with the process of praxis - the ideation, organisation and execution of purposeful skilled movements (Chu & Green 1998).

The therapist who provides an effective intervention does so by combining his or her own clinical skills and intuition with the principles of SI theory. It is a process referred to as a marriage of the "art" and "science" of therapy (Fisher, Murray & Bundy 1991). A therapist is only qualified to use this approach with clients after completing a five-day training course.

SI theory continues to influence Occupational Therapy practice. On going development has expanded the theory beyond Ayres' original ideas and diverging viewpoints have emerged around the nuances of the theory (Spitzer, Roley et al. 1996). Ayres' hypothesis that higher-level skills would appear and develop following SI therapy has been examined, but largely unsupported, by research (Vargas & Camilli 1999). However, most significantly, therapists have recently begun to apply the knowledge of sensory integrative development and the principles of SI theory to developmental disabilities (Chu & Green 1998).

SI theory and developmental disability

It is increasingly believed that autistic symptoms are the result of impaired sensory processing and that maladaptive behaviours, associated with learning disability, can be interpreted from a SI perspective. Dr Grandin, who was herself diagnosed with autism as a child, described her own over-responsiveness to auditory and tactile stimuli that caused violent and fixated behaviour, and discussed a unique form of sensory treatment she developed to break through her barrier of tactile defensiveness. She devised a squeeze machine that was modelled on a device used to hold cattle for veterinary procedures (Toigo 1992). Researchers have suggested that autistic children engage in stereotyped movement and perseveration to help modulate hypo-reactive sensory systems (Baranek, Foster & Berkson 1997) and withdraw to block-out stimulation from a hyper-reactive system (Greenspan & Wieder 1997). These sensory driven behaviours often develop into

abnormal habits or interaction styles (Gorman 1997).

Aberrant or maladaptive behaviours are being reinterpreted in the light of SI theory and are thought to be sensory driven (Chu & Green 1998). Self-stimulation and self-injury, for example are viewed as attempts to obtain sensory stimulation. SI therapy is often suggested for self-injurious behaviour. Evidence that the nervous systems of adults with developmental disabilities seem to be predominated by brainstem level activity has provided the rationale for its use. Wells and Smith (1983) reported a decrease in the frequency of self-injurious behaviour following a programme that combined tactile and vestibular activities. In addition, SI theory may explain affective reactions to sensory input. Individuals who are overwhelmed by sensory input may scream or display temper tantrums. It may be an expression of the feelings that arise when the most common of sensations are confusing and frightening and it is difficult to comprehend and communicate this experience (Gorman 1997).

Sensory integrative dysfunction is now thought to be a significant problem among adults with a developmental disability (Reisman 1993). Reisman and Hanschu (1990) have developed a Sensory Integration Inventory for Individuals with Developmental Disabilities. The inventory lists behaviours that help determine the particular sensory modulation problem(s) facing an individual with a developmental disability. The inventory examines the tactile, vestibular and proprioceptive sensory systems in this way. The individual who, for example, avoids touch (tactile defensiveness), refuses textured foods and avoids messy activities may be presenting a hyper-reactive tactile . A hyper-reactive vestibular system is suggested by fearful and irritable reactions to ordinary movement activities and an intolerance of excess movement. While poor body awareness and odd body posturing are indicative of a dysfunctional proprioceptive system.

The Sensory Integration Inventory is completed by an Occupational Therapist trained in its use. A direct evaluation is carried out when the Occupational Therapist is already familiar with the individual, otherwise, when this is not possible, the inventory is completed by the Occupational Therapist following interviews with staff who work directly with the individual and are familiar with him or her. The inventory is completed by recording an individual's typical behaviours and responses to daily living activities. The therapist analyses the results and identifies cluster or clusters of scores. The interpretation of these clusters indicates a particular modulation dysfunction which, in turn, informs the sensory integrative programme devised for each individual. Reisman and Hanschu acknowledge that just as not all individuals with developmental disabilities have SI dysfunction, so equally not every individual with identifiable dysfunctions will respond to a programme of SI therapy (Chu & Green 1998).

SI theory and music therapy

I became interested in SI theory after attending a presentation given by Occupational Therapy colleagues. The presentation explained how SI theory was being applied in the treatment of people with a learning disability. It seemed to me that music, and by extension music therapy, had a significant role to play in the process of sensory

integration. Subsequent reading, in particular Music Therapy, Sensory Integration, and the Autistic Child by Dorita S. Berger, confirmed this suspicion by highlighting that an individual's response to the elements of music and the process of playing music raised issues that were related to sensory processing and sensory integration.

First of all it is worth considering the sensory systems involved as we encourage our clients to play music with us. Music making is a multi-sensory experience that reaches multiple sensory systems at once (Berger 2002). The person who plays an instrument while simultaneously marching is integrating information from the vestibular system - to monitor and maintain their balance against gravity; the proprioceptive system - to know where their limbs are, what they are doing, and where their body is in space; the auditory system - to interpret incoming sound frequencies and confirm the response required and the visual system to provide information to guide their limbs.

If we turn to the musical instruments we introduce to our clients we will quickly realise that each one requires a separate adaptive response. A client may be required to have the ability to grab hold of a maracas at one moment and then later to flatten their hands to make sounds on a guitar or keyboard. Each instrument contributes proprioceptive feedback through the muscle contractions that take place when strumming a guitar, for example, or holding and shaking maracas. An individual's response to playing provides information about their tactile system and may, if there is resistance to strumming a guitar, suggest tactile defensiveness. Finally, each instrument provides an opportunity to motor plan in a unique way. The person who, for example, plays the recorder requires mid-line orientation and bilateral arm coordination, while playing the guitar provides tactile stimulation and develops non-parallel bilateral arm coordination and mid-line orientation.

As music therapy is a multi-sensory experience demanding a multitude of adaptive responses it follows that the way a person organises himself or herself to play offers information on their vestibular, proprioceptive and tactile functioning and their motor-planning abilities. In addition, how a person responds to each instrument or musical activity provides evidence, or otherwise, of functional adaptation. It indicates just how successfully they are integrating and interpreting sensory information and how successfully they are adapting to each new set of circumstances. In this case, as music provides a persistent stimulus, it is a delayed conditioned adaptive response. Music therapy sessions can apply music activities that address sensory integration needs to encourage appropriate responses and develop functional adaptation.

The act of playing an instrument not only involves multi-sensory input and adaptation but it also stimulates the auditory system. The detection of sound stimuli is a major interest of the brain. It provides references to the concepts of direction and distance and as the auditory system becomes more refined auditory perception skills - auditory discrimination, memory and sequencing facilitate the sensory integration and perceptual motor processes (James 1984). Berger emphasising the key role that the auditory system plays in inter-sensory integration and the impact that music therapy can have in this process writes, "when the auditory is engaged in the structured manner provided by

music, it appears that other systems tend to line up in compliance" (page 109). This is perhaps especially true when an activity combines rhythm and movement. The auditory cortex is located close to the motor cortex and consequently the auditory system, when stimulated, influences physical responses (Berger 2002). There is evidence that fine and gross motor planning is assisted through rhythmic movement carried out to rhythmic music - a process often referred to as entrainment. Berger (2002) discussing this process describes how, with music to drive the system, "a child (forgot) what he could not do because of his desire to stay with and move to the music" (page 202).

The auditory system, as we know, has a key role to play in interpreting incoming sound frequencies and confirming the response required. It is therefore hardly surprising that the auditory system plays such an important role in inter-sensory integration. If we are, for example, encouraging a client to integrate their visual, auditory and physical systems by playing only certain pitches on a xylophone, it is the auditory system that confirms the accuracy of the response and determines the future actions taken by both remaining systems. I still remember my own sense of unease when, playing keyboards with a band for the first time, I could not hear what I was playing and I did not receive the auditory feedback to confirm visual and physical input.

As music therapists the elements of music - rhythm, melody, timbre and dynamic - provide each of us with powerful tools for addressing sensory integration issues. Rhythm not only influences motor planning as discussed earlier, but it also regulates physiologic pacing and as such it has a role to play at a sub-cortical level in immediate reflexive functional adaptation. The other elements of music can also play a significant role in sensory integration. As we discussed earlier
listening and hearing are not synonymous. Auditory perception, or listening, is a voluntary activity that depends on the ability to discriminate between sounds and to interpret and remember what is heard. A person may be experiencing problems integrating auditory information in this way. They may be retrieving sounds in a non-sequential manner; they may be operating on ambient hearing - unable to scan auditory information and process what needs to be retained or what may be discarded; or they may be hypersensitive to certain pitch frequencies. As music therapists we can use melody, timbre and dynamic to examine auditory perception issues and to determine auditory tracking, memory and discrimination abilities. Any difficulty discriminating between the timbres of a pitch - for example - often parallels discrimination problems in speech and language and offers important information to music therapists and speech pathologists. Berger (2002) offers a very powerful illustration of how behaviour considered to be social avoidance (a psychological issue) stemmed from sensory overload (a physiologic problem) and of how she reached her assessment based on a young boy's response to timbre and dynamic.

Jason was distressed by the piano. Nursery songs presented with changes of volume, speed or rhythm only exacerbated his agitation. However, he was happily excited by the reverberations of a loud gong and listened transfixed to a recorder and to the flute and xylophone sounds of a keyboard. His parents described how he became highly distracted by sounds when visiting the shopping mall and this suggested that Jason operated on

ambient hearing. He picked up sounds without discrimination and all sounds appeared equal to his brain as he lacked the ability to control his auditory focus. The piano, rich in overtones, provided auditory information that overwhelmed Jason, whereas the gong and the voices on the keyboard had limited overtone frequencies that did not cause distraction and distress.

Each of us responds to music on a sub-cortical level as well as intellectually on a cortical level. As newborns we attended to a lullaby without having developed intellect, as we understood music expression at an instinctive level. It is the reason why music influences our physiologic pacing and affects our heart rate, pulse rate and blood pressure. It also links music, and music therapy, with SI theory and SI therapy.

SI theory is based on the premise that the development of adaptive higher-level cortical responses depends on the integration of sensory inputs at lower sub-cortical levels. A higher-level cortical response is required in the interpretation of music. However, as configurations of sounds can be responded to without this intellectual processing music, and by extension music therapy, has the capacity to develop adaptive responses and encourage sensory integration at the sub-cortical level that underpins SI theory.

In order to understand the link with SI therapy you will recall that a SI therapist aims to elicit an organised response in conjunction with a controlled sensory environment or in an activity carried out after SI therapy. Chu & Green (1998) identify soothing background music as one way of inhibiting hyper-reactive sensory systems and achieving a perfectly balanced state of arousal.

It is interesting that, when Persoons and De Backer (1997) described the use of VA therapy prior to active music therapy, they noted an improvement in the interactions experienced with two autistic and multiply-handicapped clients during the active music therapy that followed. VA therapy provides a 'feeling of sound' that affects physiologic pacing (Wigram 1997). Persoons and De Backer's comments are significant as they suggest that a receptive, sub-cortical experience of music, such as that offered by VA therapy, has the potential to influence arousal states and contribute to the practice of SI therapy. Persoons and de Backer observed that, "Gert's stereotyped behaviours . had almost disappeared following . vibroacoustic therapy" (page 147). While Gert himself remarked that, "vibroacoustic therapy made him feel more relaxed and less preoccupied with obsessive thoughts" (page 148).

So to conclude this section of the presentation music therapy not only encourages a sub-cortical response that links it to SI theory and SI therapy. Music therapy offers an intervention rich in sensory input. It encourages adaptive responses that enhance sensory integration and inform sensory-based interpretations of maladaptive behaviour and perhaps most significantly, it engages the auditory system - the sensory system central to inter-sensory integration.

A multi-disciplinary approach to a client with sensory integrative dysfunction

(a) Subject

Jacqueline is eighteen-and-a-half years old, 159 cm (5 ft 3 inches) tall and weighs 92kg (203 pounds). She has brown eyes and brown hair. After an uneventful birth, assessments carried out when Jacqueline was three and four years old identified that she had a marked developmental delay associated with hyperactivity and repetitive, purposeless behaviour patterns. She was at this time, with the exception of her gross motor skills, functioning at 10 months. Subsequent diagnoses questioned whether Jacqueline had Rett's Syndrome, however it is now accepted that this is not the case and she is diagnosed with Autistic Spectrum Disorder and Severe Learning Disabilities.

Jacqueline's behaviour is mood dependent. She is prone to sudden mood swings and very quickly changes from a happy to a sad or agitated state. As a result her behaviour is unpredictable and volatile. Staff and peers are frequently the targets of aggressive outbursts or else Jacqueline directs the agitation against herself - screaming, hitting herself and head banging, or her surroundings - thumping furniture. When Jacqueline was at school this behaviour were perceived as a threat to the other children and as a result she was largely educated on her own. However as she now attends a Day Hospital within the Adult Learning Disability Service Jacqueline's unpredictable behaviour has been viewed as less of a physical threat to most of her peers. Consequently she is not kept apart and occupies her own space in the day room along with the other attendees.

To date the description of Jacqueline has concentrated on her behaviour and that is to the detriment of her abilities. Jacqueline responds to her name, she is very able physically - she can walk, run and climb stairs independently, she has good manual dexterity and can perform simple self-help tasks - she can eat and dress herself. Jacqueline may have no speech and may only be able to follow simple commands - nevertheless she can make her needs known. Jacqueline indicates her needs by gesture or uses whole body communication - i.e. taking a person to what she wants. She pushes something away to indicate that she has finished with it. She uses facial expression to convey mood. She smiles, laughs and initiates physical contact when she is enjoying what she is doing.

Colleagues already working with Jacqueline were quick to stress these positives. They warned that while her ritualistic behaviour - a pre-occupation with straightening objects - often detracted from her response, nevertheless with praise, consistency and clear boundaries Jacqueline had the potential to give something of herself, and her sense of fun, to an activity.

Jacqueline was referred to music therapy as she was thought to like music. During a discussion with her physiotherapist it was brought to my attention that Jacqueline had been assessed using a Sensory Integration Inventory. The inventory highlights areas of sensory need or over

stimulation. Jacqueline's results, once plotted on the Sensory Integration interpretation form, revealed clusters of scores that indicated sensory needs in three main areas. Jacqueline presented as being hyper-reactive to tactile stimuli. She would often over respond to tactile interventions. In addition she was hypo-reactive in both her vestibular and proprioceptive systems. A hypo-reactive vestibular system explained her enjoyment of rocking, swaying, and head movements. Jacqueline carried out these movements to stimulate this system. While Jacqueline, on account of her hypo-reactive proprioceptive system, required information through muscle contractions to help her develop physical and postural skills and learn about body and spatial awareness. We concluded our discussion by agreeing that, in addition to an individual music therapy session, Jacqueline should participate in a movement session. The movement session would combine my input as a music therapist with specialist skills developed by the Occupational therapist, Physiotherapist and a nursing colleague.

(b) Movement session

The movement session that Jacqueline attends is informed by Jabadao techniques. Jabadao is a National Development Agency for Specialist Movement Work. It is a registered charity with over ten years experience of project and training work.

Jabadao acknowledges that moving or "dancing" is a fundamental part of being human regardless of physical or intellectual abilities or strengths. Moving or "dancing" plays a crucial role in supporting our well being and developing our sense of self-worth. Moving or "dancing" is one of the most ancient forms of human self-expression. Moving or "dancing" is one of the basic ways in which we explore our world, and with 80% of communication being non-verbal, it is how we communicate. When Condon examined infant (1974) and adult interactions (1975) his experiments revealed an unconscious dance as listeners moved in shared synchrony with the speaker's speech. It is this final element - communication through movement, or body language - that interested those who developed Jabadao.

Jabadao is described as a new way of understanding movement. Jabadao challenges the western concept of movement that has conditioned us to minimise our movements and to employ subtle and restrained body language, and it looks to cultures where body language and movement are seen as a major part of communication and storytelling. Jabadao is not about choreography, rather it is concerned with using movement as a medium for human communication. Its philosophy is summed up with the statement "movement is the language I use - communication is my goal."

Jabadao is increasingly being applied to the interpretation of repetitive movement patterns or behaviours often exhibited by people with a learning disability. Practitioners of Jabadao techniques suggest that, because movement is the only form of communication available to people who cannot speak, we may be ignoring attempts at communication when we ignore these repetitive behaviours. Jabadao does not attempt to explain these movement patterns or behaviours, but most importantly neither does it ignore them. Instead, the Jabadao practitioner establishes a movement dialogue by

experiencing and sharing the movement patterns of each person. In this way movement becomes a medium for communication and for building a relationship. When a relationship is established each person can then be provided with the experience of moving in different ways. In many ways it reminded me of the process of musical improvisation that underpins our work as music therapists and this prompted my interest in being involved in this session with Jacqueline.

The occupational therapist, physiotherapist and nursing colleague are not themselves Jabadao practitioners. Jabadao practitioners are people who work for the Jabadao Company and who have completed the Practitioners Course. However they attended training sessions and incorporated some of the principles and techniques introduced to them during these events into the movement sessions with Jacqueline.

Two people usually move with Jacqueline - the occupational therapist and the physiotherapist or, when one of them is unavailable, a nursing colleague who is also familiar with the technique. On rare occasions just one person engages Jacqueline in this way. Whoever is working with Jacqueline experiences movement on her terms by responding to her expressions, gestures, vocalisations and physical movements through mirroring, reflecting and patterning. Jacqueline often chooses to interact with just one person. She is overwhelmed by too much attention. When this happens the second person facilitates the interaction that is taking place. In this way those engaging with Jacqueline win her trust. In this way they built a relationship with her and communicate on a non-verbal level through movement.

The therapists also use this shared experience of movement to interrupt negative behaviours (e.g. masturbation, poking, nipping, biting and hitting) and to encourage Jacqueline to explore new ways of moving. Both the Occupational Therapist and the Physiotherapist have been trained in SI theory and in the use of the Sensory Integration Inventory. They are particularly aware of Jacqueline's sensory integrative dysfunctions and in particular of the need to stimulate her hypo-reactive proprioceptive system. Jacqueline, as I have already described, stimulates her vestibular system by rocking and swaying. These are very regular movements carried out in quite a rhythmical way on a single plane - either side to side or backwards and forwards. The therapists use the movement session to encourage Jacqueline to rotate her body rather than simply move in a single plain. They introduce other new patterns of movements to Jacqueline - for example walking backwards or moving quickly and slowly. In each case they are not only ways of developing trust and cooperation but they also contribute proprioceptive feedback through the various muscle contractions that are taking place. The therapists, aware of Jacqueline's lack of self-motivation, have also been especially encouraged to observe and then respond to movements that she has initiated during a session.

The movement sessions do not follow a prescribed order each week. They arise spontaneously out of the shared movement experience. The sessions can incorporate gross motor movements or, with Jacqueline sitting down, involve smaller movements and close, intimate interactions. A scarf is used as a prop each week to motivate and engage Jacqueline. The scarf has been chosen to stimulate her tactile system and to help

modulate the hyperactivity she displays in this sensory area. In each session there are moments when the scarf is placed over the heads of Jacqueline and the therapists. It is used in this way to create a heightened sense of intimacy.

The music I play in each session supports the movement interactions. It either portrays a movement - tossing away the scarf, taking small careful steps forward and back, rocking or swaying from side to side, for example; or it conveys the mood of the interactions taking place - anything from quiet intimacy to boisterous excitement. Jacqueline is not moving in time to my music rather, if you like, I am dancing to her tune. The music is not intended to intrude on the communication already taking place. A single voice - the string sounds on a keyboard - is used throughout each session. It is felt that Jacqueline benefits from consistency and that frequent changes of voice would only distract her.

(c) Music therapy

Music therapy sessions begin with a greeting song. The song engages Jacqueline and she enjoys being given the opportunity to strum the guitar. Jacqueline plays left-handed and coordinates her strumming with forwards and backwards rocking. While I acknowledge this response I am also aware that the physiotherapist is encouraging Jacqueline to rotate her body rather than move only within a single plane. Consequently I encourage Jacqueline to partially rotate her body when she is playing by moving the guitar to her right hand side.

Jacqueline is then encouraged to play the hand drum. She responds with a steady beat that I support with a simple song. The song words reinforce what Jacqueline is doing e.g. "Listen to Jacqueline she's playing the drum" or "The drum's up high . and Jacqueline plays the drum". The hand drum is moved around in front of Jacqueline. It is either held to her right or left, or high above her head or at her feet. The activity is developing Jacqueline's spatial awareness. Each time Jacqueline plays she is adapting to constantly changing visual and physical information and when the drum is held just over her right or left shoulder she is rotating her body as well. It is encouraging to see Jacqueline stretch just a little further as the hand drum is held higher and higher above her head. It is not difficult to imagine the muscle stretching and flexing that is taking place and how these muscle contractions are stimulating Jacqueline's hypo-reactive proprioceptive system.

Jacqueline often chooses to play a rotary drum. The drum sits in front of her on a tripod of legs. I accompany Jacqueline's playing on the guitar and encourage and prompt Jacqueline to explore different ways of playing the drum. When Jacqueline has a single drumstick I invite her to play first with her left hand and then with her right. If she is using two drumsticks I prompt her to play using alternative hands. I encourage Jacqueline to play softly as well as loudly and introduce a sung "play and . stop" prompt. Jacqueline responds with ease when invited to play the drum with just her right hand. She still requires physical guidance to stop playing and at the appropriate moment I slip my hand under the drumstick(s) to prevent them making contact with the drum skin and sounding. Jacqueline seems puzzled by any suggestions to play softly and eventually becomes distressed when prompted to beat the drum with alternative drumsticks.

However each separate adaptive response is addressing sensory issues including auditory/visual/physical integration, motor planning and vestibular and proprioceptive stimulation.

Jacqueline's proprioceptive needs are also met by playing the drum with increasingly heavier drumsticks. In the same way that we integrate information from the tactile, proprioceptive and visual systems to distinguish a red apple from a much heavier red cricket ball, information from each of these systems is informing Jacqueline of the appropriate hand position and energy required to hold each drumstick. As Jacqueline holds first an eighty gramme, then a one-hundred-and-thirty gramme and finally a five-hundred-and-fifty gramme drum stick, and raises each above her head to play her hypo-reactive proprioceptive system is being stimulated through the various muscle contractions taking place. I also introduce Jacqueline to cymbals and maracas of varying weights and sound qualities for the same reason. As Jacqueline bends her elbows and grips to hold onto each instrument it contributes to proprioceptive input. Jacqueline especially enjoys using finger cymbals and Indian hand cymbals (manjira). They are meeting her tactile needs and her manual dexterity is confirmed as she delicately grasps the finger cymbals. It is encouraging to note how Jacqueline explores different ways of playing the Indian hand cymbals. In particular as she begins holding each cymbal separately letting it slide down the string to crash on top of the cymbal suspended at the other end, I mirror her response with the twelve centimetre hand cymbals I am holding and music making, as it should in music therapy, becomes a focus for interaction and communication.

I should stress at this point that describing the process and rationale behind the music therapy session in this way fails to convey what remained a very spontaneous experience. I am following an activity plan within each session, and I am manipulating the musical environment to meet and challenge Jacqueline's sensory needs, but I also continue to use music creatively with Jacqueline. I remain open to what Jacqueline is contributing to the session. We are not playing the drum to a set pattern - up for four beats, down for four beats, to the right for two beats, to the left for two beats - rather the pace of the playing and the interactions and exchanges between us grow out of the moment and are unique to each session.

(d) Evaluating the treatment programme

The multi-disciplinary team had the overall impression that Jacqueline was responding very positively to the agreed programme of activities. Jacqueline was obviously enjoying both the movement and the music therapy sessions. She frequently smiled and appeared to be maintaining a high level of motivation and concentration throughout. However, it was agreed that these purely subjective impressions should be put to the test. The final part of today's presentation is concerned with a quantitative assessment of the treatment programme and a discussion of the issues, pertinent to music therapy practice, which arose from it.

A simple evaluation was developed to measure Jacqueline's response to the movement session and music therapy. Jacqueline's levels of interaction, participation, eye contact, motivation and co-operation were measured on a five-point scale ranging from 0 (the lowest score) to 4 (the highest score). Two trained raters used the scale to evaluate six movement and six music therapy sessions from video recordings of each session. The video had been placed on a tripod in the corner of the treatment room and was left to record automatically. The movement sessions were carried out in sequence followed by the music therapy sessions. All the sessions were held in the same treatment room, however, due to a combination of circumstances they were carried out at irregular intervals and at different times during the day. The inter-observer reliability of the scores recorded was 93% (within one scaled point).

Table 1 charts Jacqueline's response across the six movement and music therapy sessions in each of the five areas measured.

TABLE 1: Subject's level of response (0(minimum) to 4 (maximum score)

		Interaction	Participation	Eye Contact	Motivation	Co-operation
Movement Session	1	1	2	1	3	3
	2	3	3	1	3	4
	3	3	2	1	2	3
	4	1	1	0	1	1
	5	3	3	2	3	4
	6	4	4	2	3	4

Music Therapy Session					
1	3	3	3	4	4
2	3	3	2	3	3
3	4	4	2	4	4
4	3	3	3	4	4
5	4	4	2	4	4
6	4	4	3	4	4

In Table 2 the total score obtained for each of the five areas measured is expressed as a percentage of twenty-four - the total possible score.

TABLE 2: Subject's level of response
(Total score obtained for six sessions expressed as % of total score possible)

	Interaction	Participation	Eye Contact	Motivation	Co-operation
Movement Sessions	63%	63%	29%	63%	79%
Music Therapy Sessions	88%	88%	63%	96%	96%

The results confirmed our subjective impressions. Jacqueline's overall response to both the movement and music therapy sessions was a very positive one. Table 2 shows that, with just one exception, over 60% was scored in the five areas measured for each activity.

Table 2 would appear to show that Jacqueline's level of response to music therapy was higher than that recorded for the movement sessions. However, as Table 1 indicates the higher scores obtained for music therapy reflects a more consistent level of response to this activity. The scores ranged from two to four and, with over 60%, there was a predominance of the maximum score (four). Jacqueline's response to the movement session was, in contrast, more variable and the range of the scores - from zero to four - was greater. The scores for movement session four were particularly low (averaging less than one), whereas those recorded for sessions two, five and six indicated a more positive response to the movement session and a response almost comparable to that recorded

during music therapy.

Finally, the evaluation revealed a consistently lower level of eye contact in Jacqueline's response to both activities. This was surprising as anecdotal reports suggested that Jacqueline initiated and maintained good eye contact during the type of one-to-one interactions offered by the movement and music therapy sessions. The eye contact scores for the movement session ranged from 0-2 and, unlike the other areas measured, the scores for the movement session never matched the highest score obtained for music therapy - in this case - three. On this basis it is perhaps possible to suggest that, as the percentage scores in Table 2 show, the music therapy session (with a figure of 63%) was more than twice as effective as the movement session (with a figure of 29%) in encouraging eye contact with Jacqueline.

(e) Discussion

The absence of a control condition precludes any interpretation of the effectiveness of either the movement session or music therapy. If the movement session had been compared with a similar intervention in which pre-recorded music had been used it may have been possible to quantify the value of introducing 'live' music to the movement session. I also became increasingly aware that music therapy was essentially a sensory experience and as such it was inextricably linked with the process of sensory integration. Consequently I realised that, in order to apply experimental design to Jacqueline's music therapy sessions, it was not only unethical but also impossible to compare music therapy with a similar intervention in which the sensory integration elements were absent. However, while the results of the case study do not represent controlled experimental research they are nevertheless significant.

A review of the British Journal of Music Therapy (1987-2001) and Music Therapy Perspectives (1982-1984 and 1986-2001) confirmed my suspicion that, although we often describe or examine our role within a multi-disciplinary team, it is very rare for music therapists to evaluate multidisciplinary work - just 3% of 289 published articles did so. It was encouraging, for all the professions concerned, to observe and record Jacqueline's positive response to the movement session. As a music therapist I saw the results of the movement session as an important affirmation of the value of undertaking multi-disciplinary work. As music therapists, and especially I believe as music therapists working with clients who have a developmental disability, we need to broaden our conception of music therapy and acknowledge the significant role that it can play when joined in therapeutic work with other modalities.

The physiotherapist and the occupational therapist, commenting on the movement session, both recognised the valuable role music therapy had played in the session. They each observed that once involved in the session they interacted with Jacqueline unaware of the supporting music. They felt that, whereas pre-recorded music could have restricted and in a way also dictated the interactions taking place, the session benefited from my

skills as a music therapist and from the use of 'live' music that had the sensitivity and flexibility to respond to the nuances of each session.

During the course of over fifteen years working with people who have a developmental disability I have broadened my practice of music therapy to include activity based work. I believe that for many clients, either due to the degree of their developmental disability and/or the level of their musical ability, an activity based approach, similar to that employed with Jacqueline, is often more suitable than one in which the musical content is developed through improvisation. Activity based music therapy provides a way to structure an interactive music therapy programme. In an activity-based session, I use a series of carefully chosen musical activities to meet a client's individual needs. While the musical content is often pre-composed, I always remain aware of the principles of improvisation. I may vary the music to stimulate or steady a response. It may, for example, have a sense of drama to take the client by surprise, or it may be slowed down to accommodate a client's physical abilities. I use activity based music therapy programmes with individual clients, to help develop pre-language skills and improve expressive language, and with small groups to encourage peer interaction and co-operation.

I found that pursuing an activity based music therapy programme informed by SI theory gave a clear focus to my work with Jacqueline. Jacqueline's response to each activity and each manipulation of that activity became significant in the light of her sensory integrative dysfunctions and my understanding of SI theory. Consequently I was encouraged by each positive reaction Jacqueline made to the changing musical environment and by the level of her response in all the music therapy sessions. The scores recorded for the music therapy sessions
were exceptionally high - on average seventeen was scored for each session out of the possible twenty. These results suggested a highly motivated participant and they confirmed the value of meeting Jacqueline's sensory needs and developing a range of adaptive responses within an activity based music therapy programme.

I want to conclude the presentation with a final look at Dorita S. Berger's book Music Therapy, Sensory Integration, and the Autistic Child. In a chapter entitled Music Therapy in the Realm of Sensory Integration she challenges the reader to reconsider their approach to music therapy. She suggests that music therapy should be about more than just making a connection. She writes, "music for connection is only the tip of the iceberg" (page 131). She goes on to state that music therapists should be considering whether a client can play rhythmically, can recognise a familiar melody and can organise movement with rhythm. Music therapists, Berger declares, should be challenging their clients to respond to music purposefully, accurately and in a variety of manners.

Overall the results of the case study are significant as they suggest that for Jacqueline music therapy was not just about making a connection and establishing a relationship. In her case this was only "the tip of the iceberg". Music therapy met Jacqueline's sensory needs and tackled her sensory integrative dysfunctions both as an active experience through careful manipulation of the musical environment and as a passive experience in a

multi-disciplinary movement session.

References

Baranek, G.T., Foster, L.G., Berkson, G. (1997) 'Tactile defensiveness and stereotyped behaviours'. *American Journal of Occupational Therapy* 51:91-95.

Berger, D.S. (2002) *Music therapy, sensory integration and the autistic child.* London, England: Jessica Kingsley Publishers.

Chu, S., Green, D. (1998) Application of sensory processing theory in the treatment of individuals with learning disabilities. *British Institute for Sensory Integration.*

Condon, W.S. (1974) 'Speech makes babies move'. *New Scientist* 6th June: 624-627.

Condon, W.S. (1975) 'Multiple response to sound in dysfunctional children'. *Journal of Autism and Childhood Schizophrenia* 5(1): 43.

Fisher, A.G., Murray, E.A., Bundy, A. (1991) *Sensory integration - Theory and practice.* Philadelphia, Pennsylvania: F.A. Davis Co.

Gfeller, K.E. (1984) 'Prominent theories in learning disabilities and implications for music therapy methodology'. *Music Therapy Perspectives* 2(1): 9-13.

Gorman, P.A. (1997) 'Sensory dysfunction in dual diagnosis: mental retardation/mental illness and autism'. *Occupational Therapy in Mental Health* 13(1): 3-22.

Greenspan, S.I., Wieder, S. (1997) 'Developmental patterns and outcomes in infants and children with disorders in relating and communicating: A chart review of 200 cases of children with autistic spectrum diagnoses'. *Journal of Developmental and Learning Disorders* 1: 87-142.

James, M.R. (1984) 'Sensory integration: A theory for therapy and research'. *Journal of Music Therapy* 21(2): 79-88.

Mauer, D.M. (1999) 'Sensory integration therapy - Issues and applications of sensory integration theory and treatment with children with language disorders'. *Language, Speech and Hearing Services in Schools* 30: 383-392.

Persoons, J., De Backer, J. (1997) 'Vibroacoustic therapy with handicapped and autistic adolescents'. In T. Wigram, C. Dileo (eds.) *Music Vibration and Health.* Cherry Hill, New Jersey: Jeffrey Books.

Reisman, J., Hanschu, B. (1990) *Sensory Integration Inventory for adults with developmental disabilities - user's guide.* Huge, Minnesota: PDP Press.

Reisman, J. (1993) 'Using a sensory integrative approach to treat self-injurious behaviour in an adult with profound mental retardation'. *American Journal of Occupational Therapy* 47: 403-411.

Spitzer, S., Roley, S.S. et al. (1996) 'Sensory integration: current trends in the United States'. *Scandinavian Journal of Occupational Therapy* 3: 123-138.

Stonefelt, L.L., Stein, F. (1998) 'Sensory integrative techniques applied to children with learning disabilities: An outcome study'. *Occupational Therapy International* 5(4): 252-272.

Toigo, D.A. (1992) 'Autism: Integrating a personal perspective with music therapy practice'. *Music Therapy Perspectives* 10: 13-20.

Wells, M.E., Smith, D.W. (1983) 'Reduction of self-injurious behaviour of mentally retarded persons using sensory-integrative techniques'. *American Journal of Mental Deficiency* 87: 664-666.

Wigram, T. (1997) 'The measurement of mood and physiological responses to vibroacoustic therapy in non-clinical subjects'. In T. Wigram, C. Dileo (eds.) *Music Vibration and Health*. Cherry Hill, New Jersey: Jeffrey Books.

Wilbarger, P., Wilbarger, J.L. (1991) *Sensory defensiveness in children aged 2-12: an intervention guide for parents and other caretakers*. Santa Barbara, California: Avanti Educational Programs.

Vargas, S., Camilli, G. (1999) 'A meta-analysis of research on sensory integration treatment'. *The American Journal of Occupational Therapy* 53(2): 189-198.