Sensory Integration and Autism

Lecture developed by
Susan Spitzer & Diane Parham
Revised by Roseann Schaaf 2011;
Susanne Smith Roley 2010, 2013

Autism Spectrum Disorder

- Social Communication and Interaction Deficits
  - Responding inappropriately in conversation
  - Misreading nonverbal interactions
  - Deficits in developing, maintaining and understanding relationships

Social (Pragmatic) Communication Disorder

A. Persistent difficulties in the social use of verbal and nonverbal communication as manifested by all of the following:
1. Deficits in using communication for social purposes, such as greeting and sharing information, in a manner that is appropriate for social context.
2. Impairment in the ability to change communication to match context or the needs of the listener, such as speaking differently in a classroom than on a playground, talking differently to a child than to an adult, and avoiding use of overly formal language.
3. Difficulties following rules for conversation and storytelling, such as taking turns in conversation, rephrasing when misunderstood, and knowing how to use verbal and nonverbal signals to regulate interaction.
4. Difficulties understanding what is not explicitly stated (e.g., making inferences) and nonliteral or ambiguous meaning of language (e.g., idioms, humor, metaphors, multiple meanings that depend on the context for interpretation.)
Social (Pragmatic) Communication Disorder (DSM-V; APA, 2013) 315.39

B. The deficits result in functional limitations in effective communication, social participation, social relationships, academic achievement, or occupational performance, individually or in combination.

C. The onset of the symptoms is in the early developmental period (but deficits may not become fully manifest until social communication demands exceed limited capacities).

D. The symptoms are not attributable to another medical or neurological condition or to low abilities in the domains of word structure and grammar, and are not better explained by autism spectrum disorder, intellectual disability (intellectual developmental disorder), global developmental delay, or another mental disorder.

Prevalence

- 1 in 88 (CDC, 2012 from 2008 data)
- 1 in 50 expected in next analysis
- 4-5:1 boy : girl ratio

• UC Davis M.I.N.D. Institute 2009 Epidemiology study found the seven- to eight-fold increase in the number children born in California with autism since 1990 cannot be explained by either changes in how the condition is diagnosed or counted — and the trend shows no sign of abating.

• Suggest - research should shift from genetics to the host of chemicals and infectious microbes in the environment that are likely at the root of changes in the neurodevelopment of California’s children

Autism Data

- number of children served in public special education
  - 6 to 17-year-olds classified with ASD
  - 1994 - 22,664
  - 2006 - 211,610

- ASD rates
  - 1 in 88
  - Down syndrome 1 in 800 births
  - Juvenile diabetes 1 in 400 to 500
  - Childhood cancer 1.5 in 10,000

- Autism “Spectrum” Disorder
  - More than one type of autism
  - Symptoms can run the gamut from mild to severe.
  - They will present in each individual child differently.
  - A child may have little trouble learning to read but exhibit extremely poor social interaction. Each child will display communication, social, and behavioral patterns that are individual but fit into the overall diagnosis of ASD.spectrum
  - Intelligence can range from severe MR to gifted
Clinical Description

• Associated Features
  – Play
  – Cognitive functioning
  – Sensory processing
  – Movement, particularly motor planning

Bauman, 2008

– Subset of individuals with autism have neuro-endocrine and metabolic difficulties
– Decreased medical attention due to atypical communication re: pain
– Recommends *The Second Brain*, Michael Gershon

Amygdala Functions

• Amaral, 2008
  – Autoantibodies theory in subset of autistics
  – Hyperfunctional amygdala – heightened fear and anxiety due to continuous stress responses
• Davidson’s lab – shows
  – Decreased facial recognition
  – Focus on mouth not eyes
  – Variation in amygdala volume with age – increase in early childhood and decrease in adulthood

Early Identification

• MOTOR (Teitelbaum et al, 1998)
  – Head lag
  – Asymmetry when lying and crawling
  – Poor transitional movements
  – Decreased stability in sitting
  – Poor protective responses
  – Unusual gait “goose step”
  – Akinesia (inability to move) following prolonged standing

• NONVERBAL GESTURE AND VOCALIZATION
  (Zwaigenbaum et al 2005; Rogers & Williams 2006)
  – Decreased motor and social imitation
    • Possibly due to mirror neuron system
  – Poor imitation with objects
  – Poor imitation of oral-facial movements
Early Identification

• ANTICIPATORY RESPONSES (Gallese, 2006)
  – Decreased postural changes with expected social interactions
  – Decreased engagement in games such as peek-a-boo
  – Doesn’t open mouth in anticipation of spoon feeding

• INITIATING VISUAL SOCIAL CONTACT (Maestro 2006)
  – Decreased visual searching for social contact

Early Identification

• ATTENTION
• JOYFUL GAME PLAYING
• SHARED EMOTIONS
• RESPONDS TO NAME
• INTEREST IN NEW TOYS
• POINTING FOR SHARED INTEREST
• PARENTAL CONCERNS RE: LOST ABILITIES

Interventions

• Behavioral Approaches
• Language/Speech Therapy
• Occupational Therapy/Sensory Integration
• Educational, including TEACCH
• Social Skills training
• Floor-time or the Developmental, Individual Difference, Relationship-Based (DIR) Model (Greenspan & Wieder)
• Social Skills training, including social stories
• Pharmacology – some success with specific symptoms but side effects are possible
• Diets
• Holistic medicine: herbs & supplements
• Physical Therapy

Early Identification

• Etiology = neurological dysfunction
  • Limbic system
  • Cerebellum
  • Brain stem (reticular activating system/arousal)
  • Frontal lobe, Temporal lobe

• Etiology = neurological dysfunction
  • Myelin (white matter) – underconnectivity theory
  • Neurochemical abnormalities – serotonin, dopamine, etc.
  • Combination of genes + maybe interacting with environment
Etiology: a brain/neurological disorder/dysfunction

- The autism spectrum disorders (ASDs) are now commonly believed to be caused by widespread abnormalities in brain structure and function that occur prenatally and during the early stages of life
  - See Appendix B Abnormal Brain Development in Autism (Schaaf, Zapletal, Benevides, 2010) for more detailed overview of proposed neurobiological basis of ASD

Brain Development is impaired AND the neurodevelopmental trajectory, is altered.

This affects:
- cell migration
- formation of neural networks
- neurotransmitter systems may fail to perform optimally,
- communication between neurons may be impaired. major impairments in behavior and development.
- The net result is overall lack of coordination of sensory, motor, cognitive, language, and other functions resulting in major impairments in behavior and development.

Brain Size and Early Brain Overgrowth

- One of the most replicated findings in autism is that head size is significantly larger in young children with autism and that this appears to be related to an acceleration of brain growth during the first 2 years of life.
- Suggests a pervasive rather than a regionally specific abnormality.

Brain Overgrowth

- Processing Deficits are Related to Overgrowth
- Overgrowth leads to ineffective processing and connectivity
- The reason symptoms of autism are often not recognized until the second or third year of life is because higher-level functions (such as language and more complex social interaction skills— that require integration) do not emerge until the second or third year of life. The pathology has already occurred, but the symptoms do not manifest until the child begins to noticeably fall behind in these more complex behaviors. (Courchesne, Redcay, Morgan & Kennedy, 2005)

Connectivity vs. Specific Brain Regions

- A more generalized deficit theory of autism has emerged whereby impairment in brain connectivity or integration transpires as a consequence of processing and connectivity problems rather than as a consequence of specific structural or regional deficit.

Poor Conductivity Results in Impaired Information Processing

- Response inhibition is impaired, and thus, unable to inhibit behavioral impulses.
- When the processing load is increased and working memory or shifting of attention is needed, the breakdown becomes exacerbated.
- Important concepts for education and TX
- (Kana, Keller, Minshew, and Just, 2003)
Implications

- The emerging data about the relationship between brain size and brain function and the resultant alterations in information processing and integration may have implications for the development of sensory integration in autism.
- Integration of sensory information requires multiple brain areas and systems to interact in a coordinated, synchronized manner.
- Thus, poor sensory integration in autism might be viewed as a whole-brain integration deficit that involves not only processing of sensory and motor information, but also the allocation of attention and cognition to salient stimuli.

Mirror Neurons

- The mirror neuron system acts when an individual observes another performing a task.
- Provides a mechanism that converts observation into neural activity, creating a pattern for activation.

Mirror Neurons may be affected in Autism

- The mirror neuron system does not work in the same way in individuals with autism as in those without the disorder
- Behaviors such as imitation, motor planning, and motor learning may be impaired
  - (Rizzolatti et al., 2009; Buccino et al., 2006; Ramachandran & Oberman, 2006)

Brain Development and Connectivity affects Brain Areas

- Movement away from examining specific brain areas to examining whole brain functions.
- Specific Brain areas seem to be more affected than others

Specific Brain Areas are also affected

- Frontal, temporal, limbic, cerebellar structures
- See Appendix C in lecture notes for overview of Specific Brain Areas Affected in Autism

Summary of Brain Research in Autism

- Differences in neurogenesis and synaptogenesis (brain growth)
- Differences appear to affect specific areas of the brain
  - Frontal, temporal, limbic, cerebellar structures
  - In typical brains, these areas connect with other functional areas
- Additional areas not addressed here that are emerging in the literature
Hypothesized links between neurological impairment skills

<table>
<thead>
<tr>
<th>Praxis, motor skills</th>
<th>Cerebellar dysfunction, frontal lobe dysfunction, mirror neuron dysfunction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor body awareness</td>
<td>Poor brain organization, lack of coordination between brain areas</td>
</tr>
<tr>
<td>Social delays and emotional/ regulatory dysfunction</td>
<td>Frontal lobe and limbic system differences</td>
</tr>
<tr>
<td>Language delay</td>
<td>Temporal lobe and frontal lobe differences brain stem</td>
</tr>
<tr>
<td>Modulation differences</td>
<td>Reticular activating system/arousal</td>
</tr>
</tbody>
</table>

Part II
Sensory Integration in Individuals with Autism

Prevalence of Sensory Integration Dysfunction in ASD

- Auditory, Tactile and Visual systems are most frequently reported systems affected.
- There is some evidence that sensory symptoms decrease with age (Kern, et al 2006, 2007)

Common Types of SI Problems in ASD

- Altered responses to sensory input and experiences
- May show over or under responsivity;
- Excessive seeking or avoiding behaviors in response to sensory input
- May show fluctuation responses within and across sensory systems.
- Altered sensory perception and discrimination
- Poor praxis related to difficulty integrating and processing sensory information
- See Appendix A: Viewing Autism from a Sensory Integration Perspective

Rogers, S., et al, 2003

- Found significantly more sensory symptoms in children with autism in comparison to other groups (FXs, DD and Typ) (using Sensory Profile).
- Children with autism were more abnormal in taste and smell than all other groups
- Sensory Profile total score was moderately correlated with ADOS repetitive/restricted behavior score.

Rogers, S., et al, 2003

- Regression analysis showed that sensory responsivity contributed significantly to adaptive behavior (measured by the Vineland), even more than autism severity (accounts for 4% of variance; developmental level accounts for greatest amount of variance.).
- No rel between sensory symptoms and social communication suggesting that sensory impairment is an additional primary impairment, but not an autism-specific impairment.

- Found elevated levels of sensory symptoms in children with autism compared with children with other developmental delays.
- Findings were consistent across ages as young as 2 years of age.
- Also found suggestion that sensory symptoms might increase throughout preschool period and then decrease.

Atypical Sensory Responsiveness

- Dahlgren and Gillberg(1989) compared a group of children with autism, a group of children with mental retardation and a typically developing group of children over the first two years of development, showed that abnormal responses to sensory stimuli was what set apart the children with autism from the others.

Kientz & Dunn (1997)

- Found that children with Autism have widespread sensory issues as measured by the Sensory Profile
- Found no relationship between severity of autism and sensory symptom severity

Sensory Processing in ASD

- People with autism process and respond to sensory stimuli in a much different way (than typically developing).
  - “There is an obstruction between the senses and the mind, or put somewhat differently, the door to the outside (sensory) world is blocked...incoming information may be incomplete or distorted”  (Bryson, SE, 2005 in the Neurobiology of Autism, 2nd ed, p 35)

Sensory Symptoms are More Prominent in Autism

- Review of 48 empirical papers and 27 theoretical or concept papers suggests that sensory symptoms are more prominent in children with autism BUT there is not good evidence to suggest that they differentiate children with autism from other clinical groups (FXs, DD).

Anzalone and Williamson, 2000 (adapted from Lester, et al, 1995)

- Model for viewing behaviors affected by poor processing and integration of sensory information in autism
  - The Four A’s of Behavior: Arousal, Affect, Attention, Action
**Process** | **Definition** | **Proposed mechanism** | **Potential Expression in autism**
--- | --- | --- | ---
**Arousal** | Ability to maintain awareness | Arousal is influenced by detection, registration, integration and interpretation of sensory input and vice versa. Responsiveness to sensory input is linked to child’s state of arousal and may vary by child (individual variation may also occur), highlighting states of arousal may influence tactile perception to be more sensitized. | Notable arousal 
Marked responsiveness across sensory modalities 
May influence responsiveness, 
May lead to defensive behaviors (see table below)

**Attention** | The ability to focus intently on a desired stimulus or task. Includes both allocation and allocation. | Poor sensory detection and registration limits the child’s ability to attend. Children easily stimulated may be hyper vigilant. Inconsistent responding to sensory cues. Over-focusing of attention on some aspect of an object or task. | 

**Affect** | The emotional component of behavior | How a child modulates sensory input influences emotional reactivity and vice versa. Low registration of stimuli may lead to dampened affect. Over-sensitivity may lead to emotional over-reactivity. Emotional lability may occur as a result of variable sensory modulation. | Fear, Anxiety, Flat affect, Emotional lability

**Action** | The ability to engage in adaptive goal-directed behavior | Integration of sensory, motor, perceptual and cognitive schemes. Dyspraxia Impairment/delays in gross and fine motor skills Motor clumsiness | 

**Difficulty with Sensory Modulation**
- Common in children with autism (Ayres & Tickle, 1980; Baranek & Berkson, 1997; Adrien et al, 1987; Kientz & Dunn, 1997; Kootz et al, 1982; Lee, 1999; O’Neill & Jones, 1997; Ornitz, 1974; Rapin, 1991; Talay-Ongan & Wood, 2000) and affects their ability to participate in daily living activities such as eating, dressing.

**Poor detection of sensation/hypo-responsivity**
- Respond to sensation to a lesser extent than typical which may result in delayed responding
- May be related to high thresholds (Miller, Reisman, et al 2001; Dunn, 2003)
- AKA poor sensory registration or under-responsiveness or hypo-responsiveness
  - Physiological under-responsiveness has been documented by Miller, et al 1999
  - High pain tolerance (threshold?) is common
  - Children may seek sensation as a means to obtain input (hypothesis that needs to be confirmed by studies)

**Over-responsiveness to sensation/hyper-responsivity**
- Child’s respond to sensation is greater than expected
- May respond defensively to non-threatening or harmless stimuli
- Has been measures with electrodermal activity (McIntosh, Miller, et al)
- Common pattern is hyper-responsivity to auditory and tactile

**Fluctuating Patterns**
- May fluctuate between over and under-reactivity to sensory stimuli and environmental events (Baranek 1999)
- Hypo-responsivity is most frequent pattern found in autism followed by avoiding behaviors (Ben-Sasson et al 2007) but hyper-responsive patterns also found (Ben-Sasson, et al, 2008)

**Sensory Perception and Discrimination**
- Tactile
- Proprioceptive
- Visual
Specific sensory processing differences in Autism

- Tactile, Auditory and Visual are most frequently reported
- Auditory – The literature reports between 58 – 100% of have difficulty (Greenspn and Weider, 1997). Sound sensitivity is most common, but interpretation of auditory cues is also affected in many.

Tactile

Tactile hyper-responsivity is also common. Baranek, et al 1997 found that children with higher levels of tactile hypersensitivity were more likely to display rigid or inflexible behaviors, repetitive verbalizations, visual stereotypes and abnormally focused attention (as cited in Tomchek, 2011).

Visual

- avoidance of eye contact may be early feature of autism
- Unusual visual inspection of objects
- Some have strength in visual perception (Happe, 1996; Parham, Mailloux, & Roley, 2000) but over-focusing or hypervigilance may also be present.

Other motor issues in autism

- Motor delays
- Head lag may be an early indicator (Flannigan, et al 2011)
- Delays in gross and fine motor skills often present
- Motor clumsiness may occur
- Imitation
- Praxis
- Posture (Minshew, et al 2004)
- Gait and balance
- Shorter stride length
- Repetitive or stereotypic motor mannerisms are often present
- Low muscle tone found in 51%. (Ming, et al 2007)

Praxis Difficulties (Ayres, 1979)

- Ideation (idea of what to do with novel materials, setting, activity)
- Imitation (Rogers & Williams, 2006)
- Initiation
- Timing & sequencing

Praxis in Autism

- Dyspraxia is common (DeMyer, Barton, & Norton, 1972; Huebner, 1992; Parham, Mailloux, & Smith Roley, 2000; Maniviona & Prior, 1995).
- Often related to poor processing and integration of sensation.
- Includes problems in:
  - Ideation (idea of what to do with novel materials, setting, activity)
  - Imitation
  - Initiation
  - Timing & Sequencing/anticipatory control
- Parham, Mailloux, Smith Roley, et al (2011) found that praxis tests of SIPT were consistently lower in subjects with autism, in particular oral praxis.
- (see Baranek, Parham, & Bodfish, in press)
Dyspraxia in Autism
(Dziuk et al, 2007)

• Core feature of autism
• Generalized praxis deficits beyond basic motor skill issues especially related to tool-use and social/communicative gestures
• Impaired performance of skilled gestures
  — Florida Apraxia Screening Test (Revised)
    • Gestures to command
    • Gestures to imitation
    • Gestures with tool use (hammering/waving)
  — Meaningless gestures

SIPT Performance
(Parham, Mailloux, & Roley, 2000)

• 20 children with autistic disorder (high functioning)
• 20 typically developing, matched for age, gender, & ethnicity

Results

• All SIPT scores were significantly different between groups except Localization of Tactile Stimuli (LTS)
• Conditional logistic regression identified Oral Praxis test as the best predictor of being in the autism group

What are the characteristic sensory integration and praxis patterns of children with ASD?

— SIPT
— Relative strengths
  — Visuopraxis
    — Visual Perception & Visual Praxis
• Significantly low mean scores
  — Somatopraxis
    — Imitation Praxis
    — Vestibular Bilateral Integration
    — Somatosensory
    — Praxis on Verbal Command

Correlations Among SIPT functions and SPM scores for Children with ASD

<table>
<thead>
<tr>
<th>SPM</th>
<th>SIPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-Home</td>
<td>Vis Perc</td>
</tr>
<tr>
<td>C-Main Classroom</td>
<td>Vis Praxis</td>
</tr>
<tr>
<td>Social – H</td>
<td>**</td>
</tr>
<tr>
<td>Social – C</td>
<td>***</td>
</tr>
<tr>
<td>Planning-Idea-H</td>
<td></td>
</tr>
<tr>
<td>Planning-Idea-C</td>
<td>*</td>
</tr>
<tr>
<td>Total Sensory–H</td>
<td></td>
</tr>
<tr>
<td>Total Sensory–C</td>
<td>**</td>
</tr>
</tbody>
</table>
Sensory Integration Patterns in ASD

**Visual Praxis – Strength** in motor free visual perception and visual construction

**Somatodyspraxia**
Somatosensory processing of tactile and proprioception
Dyspraxia including poor imitation, sequencing, and following unfamiliar instructions

**Vestibular-related challenges**
Standing, Walking, Balance below average; offcentered; Postrotary nystagmus and poor postural control

**Atypical Sensory Reactivity**
Heightened responses to a variety of stimuli, atypical pain responses with under-responsiveness to body-centered sensations

*Dyspraxia* more predictive of Social Participation Deficits than sensory reactivity

More on Motor Issues
See Appendix C

First Hand Reports

- The Impact of A Sensory Integration Dysfunction is Especially Striking in First-Hand Reports by Adults with Autism

- Different Sensory Processing= Different Life Experiences & Responses

First-Hand Reports by Adults with Autism

- Ears “as helpless microphones, transmitting everything, irrespective of relevance, at full, overwhelming volume” (Temple Grandin in Sacks, 1993, p. 109)

- “I had never felt my body comfortably in someone’s embrace. My skin response had been as much a barrier as a wire cage. I had learned to endure, but not enjoy.” (Blackman, 1999, pp. 5-6)

Sample First-Hand Reports

- “I could feel but had no need of touch and appeared unable to feel pain. I could feel physical sensations but they were slow to register and were floaty and without distinct location or meaning or even a developed sense of whether they were internal or external to me. There was no response because the information, though perceived, remained unprocessed and uninterpreted.” (Donna Williams, 1998, p. 53)

Emotion and Identity

- Ethnographic study Bagatelle, 2008
- Adults have complex emotional lives
- Desire meaningful relationships
- Use occupation as means to express self and construct meaningful life
Part III
Assessing Sensory Integration in Children with Autism

Methods for Assessing Sensory Integration

- Methods to gather information
- 1. Observational assessments
- 2. Standardized testing
- 3. Hypothesis generating
- 4. Narrative Interviews
  - Interviews Parents, Teachers, Child, others

Observations of Problematic Behaviors, Play & Adaptive Behaviors

- Applied sensory analysis—“examine the sensory antecedents, both long term and short term, for adaptive and maladaptive behaviors” (Tomcheck, 2001, p. 110)
- Stereotypies—consider potential triggers including (but not limited to) sensory triggers
- imitation skills
- responsiveness—does the child respond (register input) or avoid sensory experiences?
- acknowledge attempts at self-regulation
- Obtain data from parents (sensory history) – see Smith-Roley & Schaaf (2006) for sample.

Standardized Assessments

- Sensory Profile (Dunn, 1999)
- Sensory Processing Measure (Parham, Ecker, Miller-Kuhanek, et al 2007)
- Sensory Integration and Praxis Tests (Ayres, 1989)
- Others (Clark, Miller-Kuhanek, & Watling, 2004; Spitzer et al., 1996; Tomchek, 2001)

“Behavior” is Communication

- “Children with autism engage in challenging behavior to express wants, needs, or emotions. All behaviors have a communicative function, and it is up to the team to determine what exactly the child is trying to communicate.” (Kientz & Miller, 1999, p. 3)

“Behavior” is Communication

- The same behavior may indicate different things depending on the situation.

- Possible reasons (Durand & Crimmins, 1992)
  - Sensory seeking or avoiding
  - Escape
  - Attention
  - Tangible
“Behavior” is Communication

- Many communication cues are sensory-based:
  - Body movement -- Intonation
  - Touch -- Pitch
  - Close space -- Facial expression
  - Pauses
  - Rhythm & timing
  - Synchrony

Part IV - Treatment

Sensory Integration Intervention for individuals with autism – SI vs Sensory Based

Treatment for ASDs

- A comprehensive educational program (education, speech, behavioral therapy) is the most effective in achieving optimal outcomes (National Research Council, 2001).
- Includes occupational therapy services to address sensory and sensory-motor delays.
- The therapist chooses individually tailored sensory-motor activities for the child based on areas of need identified by systematic assessment

SI Intervention for Individuals with Autism

- Purpose: improve adaptive functioning by reducing problems related to sensory processing
- Expand initiation and ideation
- Improve functional/adaptive behaviors and skills
  - OTs who feel competent in their use of SI perceived more improvement in the children with Autism & PDD
- Most common OT approach with children with ASDs

Sensory Integrative Treatment Approach = facilitation of sensory integration

Sample Adaptive Responses

- Responsive to environment & use of space
- Social relatedness & communication
- Imitation
- Complexity & flexibility of response
- Initiating & organizing activity
- Hand skills & tool use
- Time spent in activity
- Frustration tolerance
Respect the Individuality of the Child

» Look for talents and interests
» Who is this child?
» Channel interests and obsessions, and engage talents, to expand skills & experiences (Spitzer, 2003, 2004)

Six studies that Investigate OT/SI with ASD (Schaaf, 2010 in Volkmar, F – Evidence Based Practices in ASD)

- Two are group comparison designs
- Three are single subject designs
- One is a case study.
- Collectively, they report that individuals with ASD and SD who receive occupational therapy using a sensory integrative approach demonstrated gains in play, individualized goals, and social interaction (Ayres & Tickle, 1980; Case-Smith & Bryan, 1999; Linderman & Steward, 1999; Schaaf & Nightlinger, 2007; Watling & Dietz, 2007) and a decrease in sensory symptoms (Fazlioglu & Baran, 2008).

Evidence for SI Intervention for Individuals with Autism

See Appendix D for review of studies using sensory integration and sensory-based interventions.

» Sensory Integration showed promising evidence
» Touch-based therapies showed promising evidence
» Very mixed findings with weight (including weighted vests)
» Weak findings for auditory therapies, Wilbarger protocol, other specific sensory techniques

Evidence for non-SI Sensory Based Intervention

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Key Authors</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massage Pressure</td>
<td>Field Silva</td>
<td>Variable interv; no control group; no fidelity</td>
</tr>
<tr>
<td>WT Vests</td>
<td>Reichow, B Fertel-Daly, D Kane, A</td>
<td>Inconclusive No strong evidence</td>
</tr>
<tr>
<td>Auditory</td>
<td>Corbett Bettison</td>
<td>Inconclusive No strong evidence</td>
</tr>
</tbody>
</table>

Evidence for Sensory Based Interv

<table>
<thead>
<tr>
<th>Therapy</th>
<th>Key Authors</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brushing</td>
<td>Kimball, J Wilbarger, P</td>
<td>Very weak No subject descriptions No report of statistical significance</td>
</tr>
<tr>
<td>Therapy Balls</td>
<td>Deitz, J Schilling Schwartz</td>
<td>Promising</td>
</tr>
</tbody>
</table>

Ways to Apply Sensory Integration Principles

- Build on Sensory Strengths
  - Sensory play may provide more options for social interaction than traditional play
  - Use the sensory modality which is most preferred, accessible, works the best (often visual) to teach other skills
Compensate by altering tasks, environments, developing strategies

- Provide visual cues to assist in communication/understanding—such as PECs, picture schedules, etc. (see Watling, 2001, 2004 for helpful suggestions)
- Alert Program (Williams & Shellenberger)
- Tools for Teachers (Diana Henry)
- Specific skill training (e.g., handwriting programs)
- Sensory “social stories” (Carol Gray) to gain understanding and envision ways of using strategies
- Shape daily routines & activities: Lifestyle Redesign

Apply SI Knowledge

- Modify tasks & environments
- Develop self-management strategies
  - Provide visual cues
  - Alert Program
  - Tools for Teachers
  - Social stories
  - Sensory preparation & restoration
  - Expand on interests

More strategies

- Sensory “social stories” (Carol Gray) to gain understanding and envision ways of using strategies
- Shape daily routines & activities: Lifestyle Redesign
- 4. Sensory activities may be needed before (to prepare), during, and after (to recover from) challenging activities
  - Balancing activities to include energizing activities & restorative niches throughout the day (Blanche, 2001)
- 5. Many sensory needs are life-long
- 6. Some sensory needs must be met on a daily basis
  - Build on individual’s interests

Consultation

- Home visits/consultation and “home programs” are often needed to ensure carryover and generalization outside of treatment sessions to meet long-term needs

Carryover/Generalization

- Outside treatment sessions
- Beyond treatment
- “Home Program”
- Self-Regulation strategies/compensations for some needs
- Social stories to gain understanding and envision ways of using strategies

If sensory strategies are used with behavioral approach

- Make sure the child has plenty of opportunities to get the sensory input their body needs
- They may need more on some days than other days—thus reinforcement schedules must vary
- Needed sensory input cannot be withheld as “punishment”
- Reframe behavior for parents & teachers—offer alternative explanations for behaviors/difficulties (see Appendix A; Spitzer, 2004)
Comparison of Sensory Integration and Behavioral

**Sensory Integration**
- Engage inner drive (intrinsic motivation)
- Concern with child's experiences
- Underlying reasons for problem behaviors
- Facilitate ideation & self-regulation
- Encourage flexibility and adaptability
- Facilitate compliance with adult rules
- Encourage specific skill building through routine

**Behavioral**
- Selected reinforcers (extrinsic motivation)
- Concern with adults' behavior management
- Extinguish problem behaviors
- Facilitate compliance with adult rules
- Encourage specific skill building through routine

See Appendix E – Comparison of Sensory Integration with Behavioral Therapy

Outcomes

- Improved engagement in activities
- Improved ability to hold still and pay attention
- Increased tolerance to change
- Improved ability to generalize
- Improved social language
- Increased fine motor skills
- Improve praxis
- Improved organizational skills
- Improved quality of life for family

Important Resources for SI with ASD