# Sensory Integration Approaches for Children with Autism Spectrum Disorder

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# Learning Objectives

Following this presentation, participants will be able to:

1) Critique findings of national consensus reports on the evidence of sensory integration approaches for children with ASD.

2) Describe the differences between sensory integration approaches designed to remediate deficits in underlying neurological processes from those designed to provide the child with sensory-based compensatory strategies.

3) Describe at least three types of sensory integration problems observed in children with ASD.

- Symptoms of ASD are heterogeneous

- Widespread reports of sensory abnormalities
  - Hyporesponsiveness/Hyperresponsiveness
    (Baranek et al., 2006; Rogers and Ozonoff, 2005; Kern et al., 2006; Liss et al., 2006; Leekam et al., 2007)
  - Dyspraxia
    (Smith, 2004; Williams et al., 2006; Mostofsky et al., 2006; Vernazza-Martin et al., 2005; Mari et al., 2003; Weimer et al., 2001)
  - Perceptual-motor integration
    (Vanvuchelen et al., 2007; Muller et al., 2004)
  - Postural Control
    (Minshew et al., 2004; Kohen-Raz et al., 1992)

# Treatment approaches for ASD are as heterogeneous as symptoms:

- Pharmacological
- Behavioral
- Educational
- Sensory Integration Therapy (SIT) – Lumping!!!
- Dietary

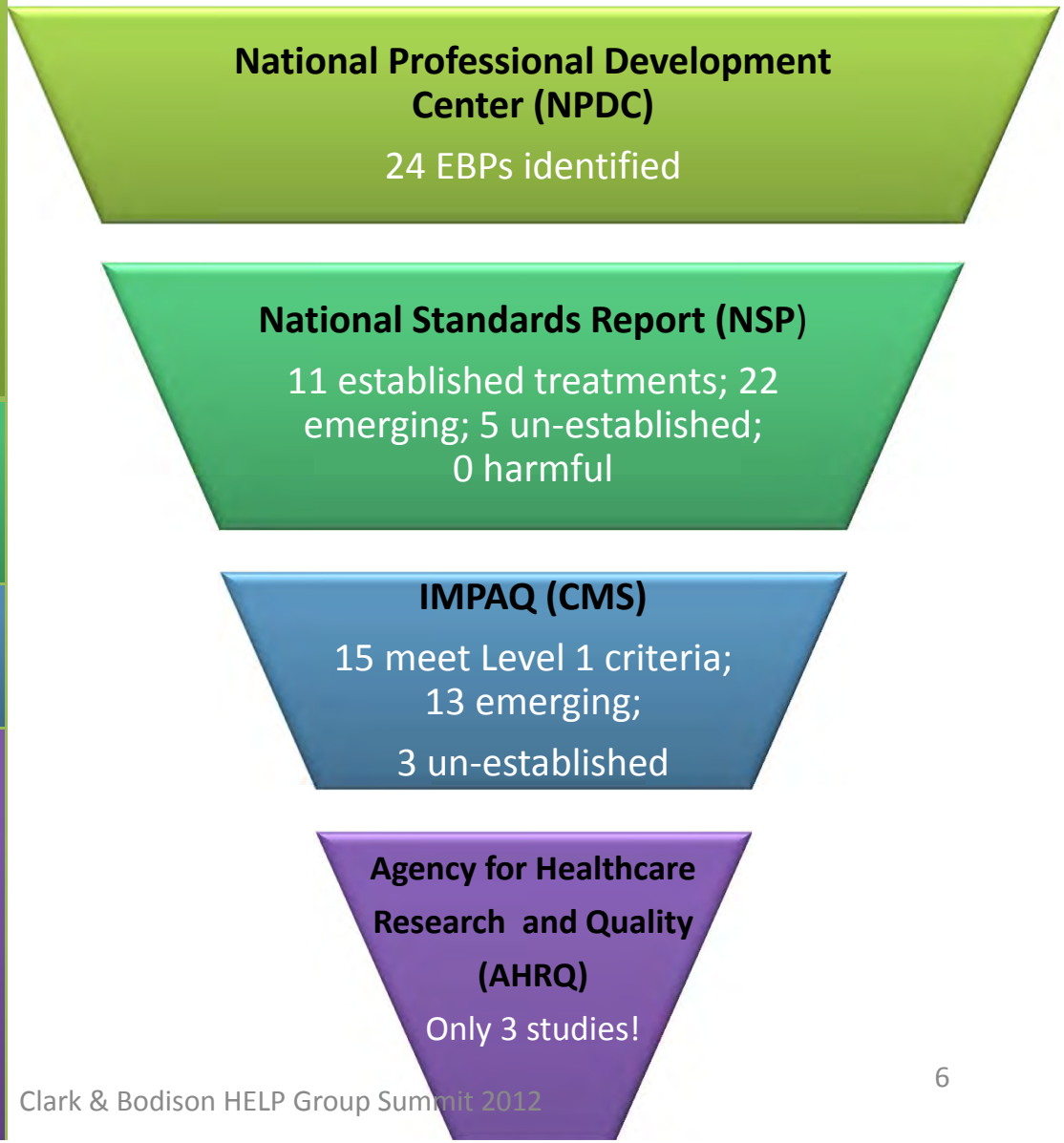
# Which of these approaches are evidence based?*

- National Professional Development Center Report (2010) (NPDC) *(Study window: 1997-2007)*
- National Standards Project (2009) (National Autism Center) (NSP) *(Study window: 1957-2007)*
- IMPAQ – Centers for Medicare and Medicaid Services (2010) (CMS) (*Study window: 1998-2008)*
- Agency for Healthcare Research and Quality (2011) (AHRQ) *(Study window: 2000 – 2010)*

***Depends on:**

**the criteria applied & the study window**

| | |
|---|---|
| **NPDC** | **-2 experimental or quasi-experimental group designs carried out by independent investigators**<br><br>**-At least 5 single-case design studies from at least three independent investigators**<br><br>**-A combination of at least one experimental/quasi-experimental study and three single-case design studies from independent investigators** |
| **NSP** | -Extended study window back to 1957<br>**Raised the bar:**<br>-NPDC criteria plus employed a 5-point scientific merit rating scale |
| **IMPAQ** | Used Similar Criteria to NPDC |
| **AHRQ** | -Narrowed study window from 2000-2010<br><br>**Raised the bar again:**<br>-Excluded studies N<10<br>-Considered whether studies had been replicated, used objective outcomes, etc.<br><br>**Conclusion:** Insufficient evidence for all interventions except pharmacologic ones- but these have worrisome side effects |



# How Did SIT Fair in These Reviews?

**NPDC Report:**

- SIT is not listed among the 24 evidence-based interventions

- So what kinds of evidence were used to establish 2 out of the 24 EBPs?
  - Differential Reinforcement:
    # of studies: 6
    Total N: 10
    Level of evidence: all studies are Level IV
  - Social Skills Groups:
    # of studies: 6
    Total N: 55
    Level of evidence: Level III (1); Level IV (5)

# How Did SIT Fair in These Reviews?

(continued)

## NSP Report:

- Un-established (along with academic intervention, auditory integration training, facilitated communication, gluten and casein-free diet)

## IMPAQ Report:

Not classified

## AHRQ Report:

- Insufficient evidence (like virtually everything else)

# The good news…

After the end date of the window for inclusion of studies for most of these reports, new experimental studies have been completed demonstrating SIT effectiveness.

- Smith, S.A., Press, B., Koenig, K.P., & Kinnealey, M. (2005)
- Fazlioglu, Y., & Baran, G. (2008)
- Pfeiffer, B., Koenig, K., Kinnealey, M., Sheppard, M., & Henderson, L. (2011)

**We now have significantly better evidence**

- Smith, S.A., Press, B., Koenig, K.P., & Kinnealey, M. (2005). Effects of sensory integration intervention on self-stimulating and self-injurious behaviors. *American Journal of Occupational Therapy, 59,* 418-425.

  - **Type:** Alternating design
  - **N** = 7; 8-19 years of age
  - **Diagnoses:** PDD or MR (demonstrated self-stimulatory or self-injurious behavior)
  - **Intervention arms:**
    - SIT
    - Table top activities
  - **Duration/intensity:** 4 week study with 30 minute intervention sessions five times per week; weeks 1 and 3 were table top activities while weeks 2 and 4 were SIT
  - **Results:** Self-stimulatory behaviors reduced by 11% one hour after SIT

- Fazlioglu, Y., & Baran, G. (2008). A sensory integration therapy program on sensory problems for children with autism. *Perceptual and Motor Skills, 106*(2), 415-422.

  - **Type:** Randomized Controlled Trial
  - **N** = 30; 7-11 years of age
  - **Diagnoses:** Autism (based on DSM-IV criteria)
  - **Intervention arms:**
    - SIT (sensory diet)
    - Standard special education classes
  - **Duration/intensity:** 45 minute sessions, 2 times per week for a total of 24 sessions
  - **Results:** Sensory/behavior problems improved following SIT

- Pfeiffer, B., Koenig, K., Kinnealey, M., Sheppard, M., & Henderson, L. (2011). Effectiveness of sensory integration interventions in children with autism: A pilot study. *American Journal of Occupational Therapy, 65,* 76-85.

  - **Type:** Randomized Controlled Trial
  - **N** = 37; 6-12 years of age
  - **Diagnoses:** Autism or PDD- NOS (based on DSM-IV criteria) who were also identified with sensory processing disorder
  - **Intervention arms:**
    - SIT
    - Fine motor intervention
  - **Duration/intensity:** 45 minute sessions, 3 times per week for 6 weeks
  - **Results:** Significant gains on goal attainment scales; significant decrease in autistic mannerisms in SIT group

# Quantitative Synthesis of Three Studies

- Carlson performed meta-analysis on these three new studies combining z-scores across studies known as Stouffer procedure

- Results:
  - Combined z-score=6.493, $p<0.00000000005$
  - Used only controlled experiments
  - Adjusted for small sample sizes
  - Adjusted for inconsistent effects within studies

- Conclusion
  - the likelihood is less than 1 in 20 billion that such a favorable result for SIT could have arisen by chance

# So what ***is*** SIT anyway?

# Confusion About SIT Effectiveness Studies with Children with ASD

- Baranek (2002)
  - 29 SIT (includes sensory diet, patterning, AIT, touch-based, exercise, etc.)

- Schaaf (2011)
  - 7 SIT
  - 4 Touch-based
  - 6 Weighted vests
  - 4 AIT
  - 3 Other

*Truth, like infinity,*
*is to be forever*
*approached but*
*never reached.*

Ayres, A. J. (1972) *Sensory Integration and Learning Disorders.*
Los Angeles: Western Psychological Services. p. 4.

# A. Jean Ayres

- Pioneer in the development of sensory integration theory and intervention
- Developed over 20 standardized tests
- One of the first occupational therapists engaging in research (1950's through 1980's)
- Published over 50 papers, most in peer-reviewed scientific journals

# Animal Model Research on Enriched Environment Conditions

SIT was informed by Marian Diamond's findings on the effects of enriched environments on neuroplasticity in the rat cerebral cortex.

Diamond, M. C., Krech, D., & Rosenzweig, M. R. (1964). The effects of an enriched environment on the histology of the rat cerebral cortex. *Journal of Comparative Neurology, 123*, (1): 111-119.

# Animal Research on Enriched Environment Conditions

- Greater weight and thickness of cortical tissue
- Increase in total acetylcholinesterase (AChE) activity in the cortex
- Brain responsivity to environmental "pressure" demonstrated

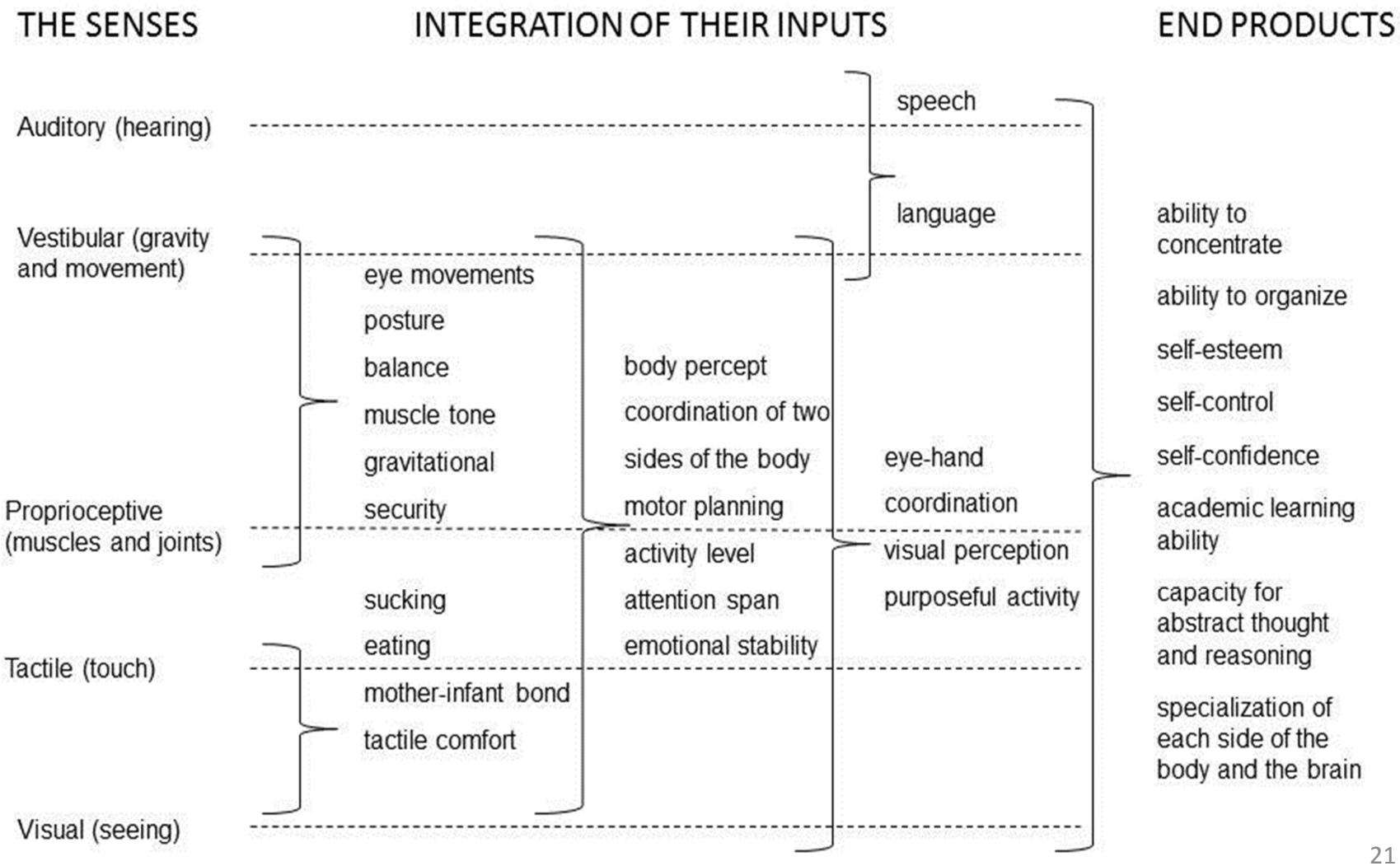
Bennett, E. L., Diamond, M. C., Krech, D., & Rosenzweig, M. R., (1964). Chemical and Anatomical plasticity of brain: Changes in brain through experience, demanded by learning theories, are found in experiments with rats. *Science, 46,* 610-618.

# The Theory in a Nutshell

- Ayres observed children who have overresponsivity or underresponsivity to touch, movement, sights, sounds, etc. AND coordination problems.
- Hypothesized that these problems are due to the brain's inability to link information coming from various senses.
- Suggested that this impacts development, behavior, and learning.
- Theorized that engagement in sensorimotor activities in an enriched environment would improve the brain's ability to process and use sensory information.

Ayres, A. J. (1972). *Sensory integration and learning disorders*. Los Angeles, CA: Western Psychological Services.
Ayres, A. J. (1975). Sensorimotor foundations of academic ability. In W. M. Cruickshank & D. P. Hallahan (Eds.), *Perceptual and Learning Disabilities in Children (vol. 2).* New York, NY: Syracuse University Press.

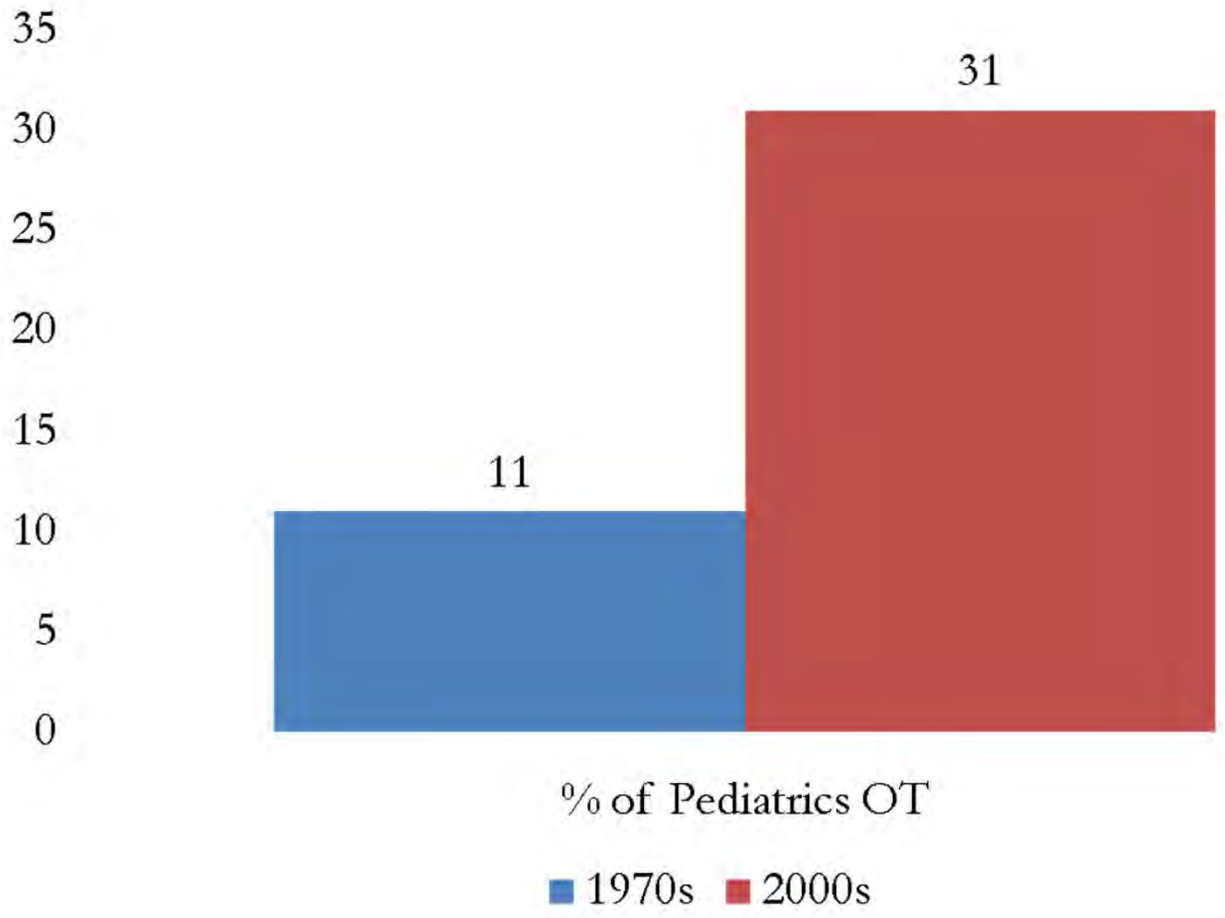
# The Senses, Integration of their Inputs, and End Products (Ayres, 1979)






Ayres, A. J. (1979). *Sensory integration and the child*. Los Angeles, CA: Western Psychological Services.

# SEISMIC GROWTH IN PEDIATRIC PRACTICE



# *but…*

– "she was excluded from, rather than embraced by, the community of therapists" (Peters, 2011)

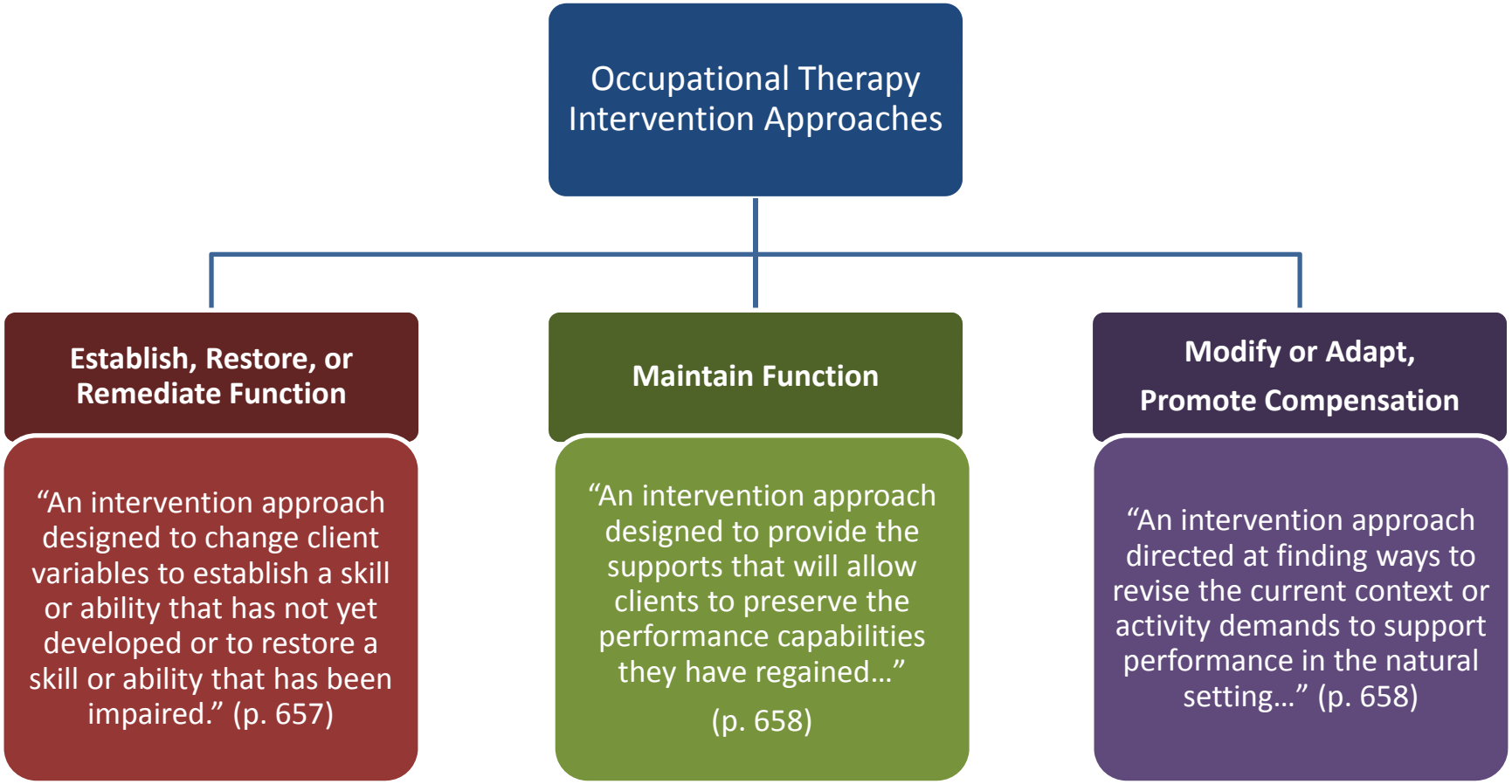
"When Jean Ayres was at what I would call the height of her game in terms of sensory integration, teaching, and trying to teach the rest of the professions, she was greeted with real hostility… She met with a lot of hostility from people who **didn't want to believe what she was saying**."
(Lela Llorens in Peters, 2011)

Peters, C.O. (2011). Powerful occupational therapists: a community of professionals, 1950–1980, *Occupational Therapy in Mental Health, 27*(3-4), 199-410.

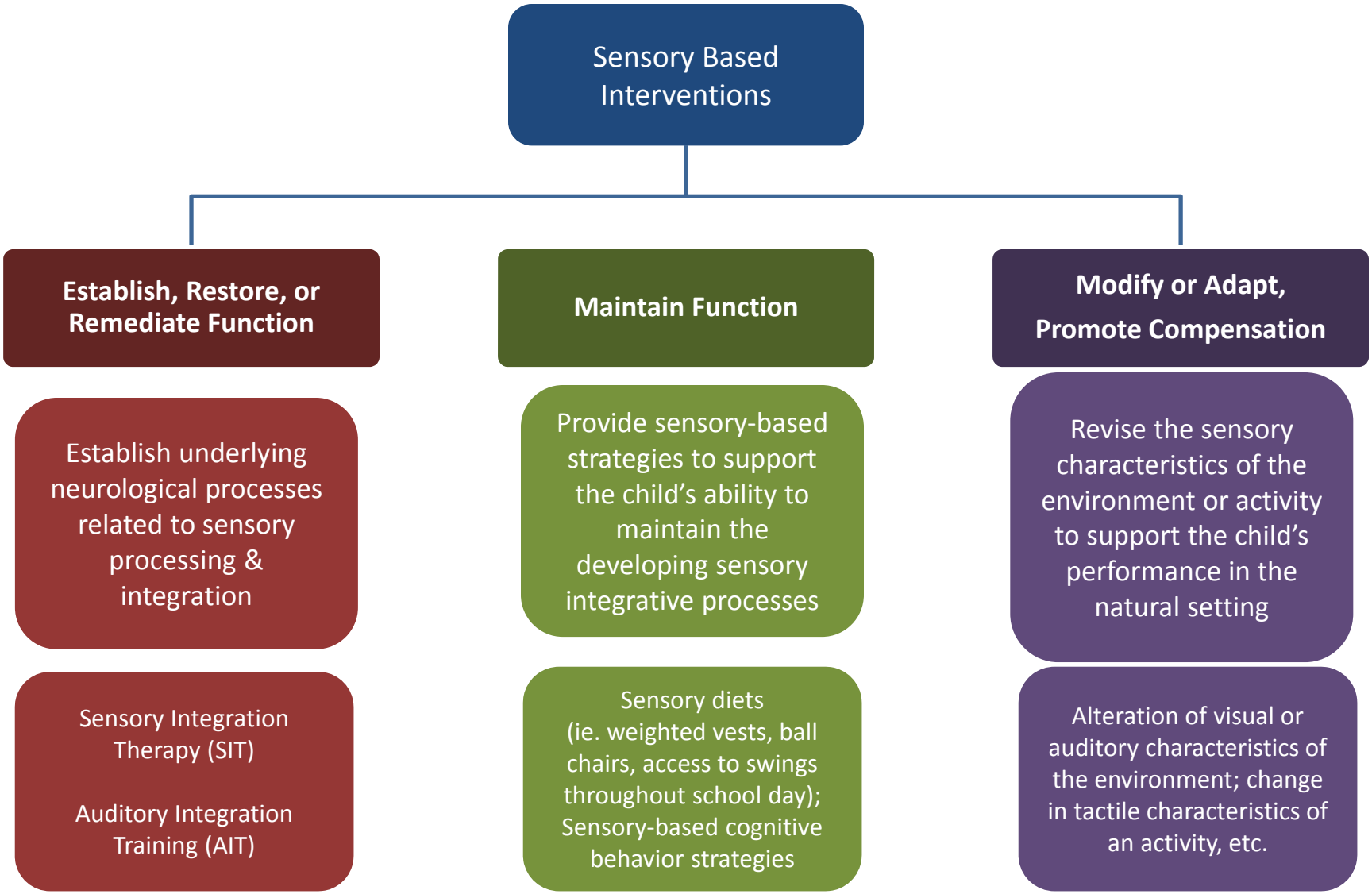
# Adoption of SI Knowledge by OT's & Other Professionals

- Orthodox – acceptance by OT community and establishment of practice standards
- Counterpointal – lumping and filtering by other disciplines/professionals
- Borrowed – who is qualified to apply knowledge?
- Revelatory – explanation of knowledge for lay person
- Rationalized – application shaped by protocols, plans, costs analyses

Arluke, A. (1991). The transformation and fate of formal knowledge: The case of sensory integration. *Current Research on Occupations and Professions, 6*, 179-199.




American Occupational Therapy Association (2008). Occupational therapy practice framework: Domain and process (2nd ed.). *American Journal of Occupational Therapy, 62*, 625-283.


Sensory Based Interventions
Establish, Restore, or Remediate Function
Maintain Function
Modify or Adapt, Promote Compensation
Establish underlying neurological processes related to sensory processing & integration
Provide sensory-based strategies to support the child's ability to maintain the developing sensory integrative processes
Revise the sensory characteristics of the environment or activity to support the child's performance in the natural setting
Sensory Integration Therapy (SIT)
Auditory Integration Training (AIT)
Sensory diets (ie. weighted vests, ball chairs, access to swings throughout school day); Sensory-based cognitive behavior strategies
Alteration of visual or auditory characteristics of the environment; change in tactile characteristics of an activity, etc.

# Do Children with ASD Demonstrate Sensory Integration Problems?

# Ayres' Perspective on ASD

- Hypothesized sensory registration/processing problems in children with autism – linked to interaction of amygdala/hippocampus

- Hyper/hypo responsive and praxis problems

- Processing problems could be responsible for some of the "behavioral" symptoms observed in autism

Ayres, J. A. – 1972, 1975 & 1979

# Domains of Impairment in ASD

Table 1 Domains of impairment in autistic spectrum disorder (ASD)[a]

| Domain | Autism | Asperger | PDD-NOS | ASD |
|---|---|---|---|---|
| social communication | required | required | required | |
| language | required | – | variable | |
| repetitive, restrictive behaviors | required | required | variable | |
| sensory abnormalities | >90% | 80% | variable | 94% |
| developmental regression[b] | 15%–40% | ? | ? | 15%–40% |
| motor signs[c] | 60%–80% | 60% | 60% | 60%–80% |
| gross motor delay | 10% | ? | ? | 5%–10% |
| sleep disturbance | 55% | 5%–10% | 40% | 50% |
| gastrointestinal disturbance[d] | 45% | 4% | 50% | 4%–50% |
| epilepsy[e] | 10%–60% | 0%–5% | 5–40% | 6%–60% |
| comorbid psychiatric diagnosis[f] | 70% | 60% | >25% | 25–70% |

Geschwind, D. H. (2009). Advances in Autism. *The Annual Review of Medicine, 60,* 367-380.

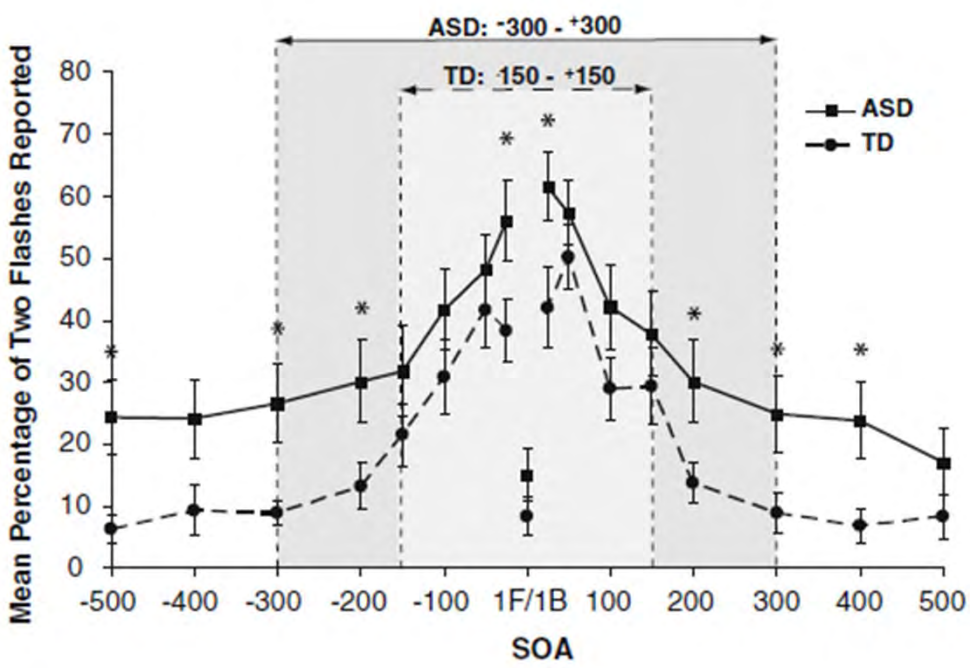
# Research Related to Sensory Processing in Children with ASD

- Co-occurrence of hyper-responsive sensory features and repetitive behaviors
- Suggest shared neurobiological mechanisms
- Interventions may need to address the co-occurrence to maximize intervention effectiveness

Boyd, BA, Baranek, GT, Sideris, J, Poe, MD, Watson, LR, Patten, E & Miller, H. (2010). Sensory features and repetitive behaviors in children with autism and developmental delays. *Autism Research, 3,* 78-87.

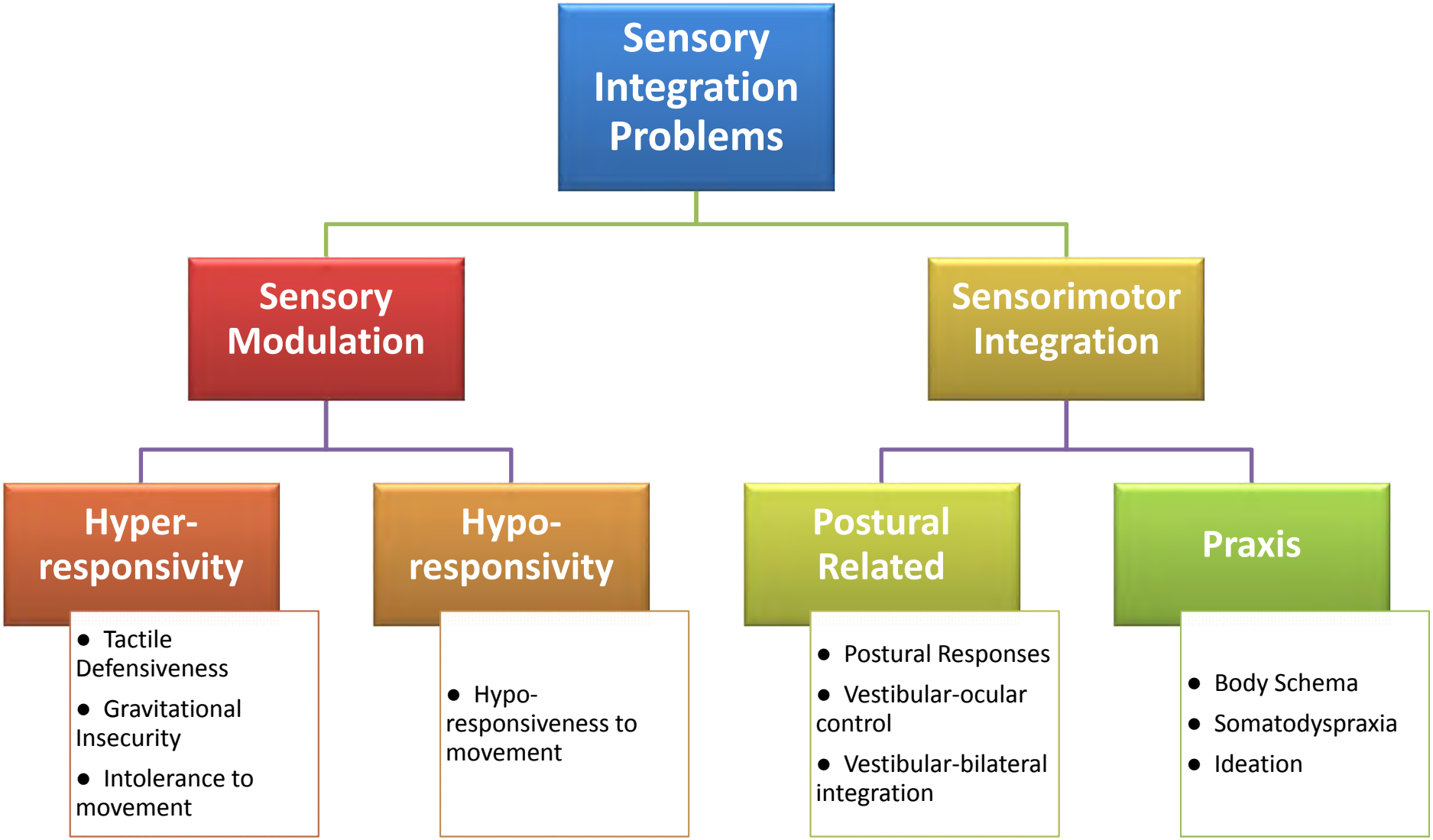
# Research Related to Sensory Processing in Children with ASD (continued)

Children with ASD have an extended temporal window within which they bind together visual and auditory multisensory stimuli, as compared to same age typically developing peers.




Foss-Feig, JH, Kwakye, LD, Cascio, CJ, Burnetter, CP, Kadivar, H, Stone, WL & Wallace, MT. (2010). An extended multisensory temporal binding window in austism spectrum disorders. *Experimental Brain Research, 203,* 381-389.

# What are the Common Sensory Integration Problems & How are They Identified and Treated?

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# Therapist Qualifications

- Registered occupational therapist, physical therapist or speech-language pathologist
- Minimum of 50 hours post-professional training in sensory integration theory, evaluation techniques and intervention
- History of provision of SI services under the mentorship of an experienced clinician

Parham, L. D., Cohn, E. S., Spitzer, S., Koomar, J. A., Miller, L. J., Burke, J. P., . . . Smith Roley, S. (2007). Fidelity in sensory integration intervention research. *American Journal of Occupational Therapy, 61*(2), 216-227.; Parham, L. D., Roley, S. S., May-Benson, T. A., Koomar, J., Brett-Green, B., Burke, J. P., . . . Schaaf, R. C. (2011). Development of a fidelity measure for research on the effectiveness of the Ayres sensory integration intervention. *The American Journal of Occupational Therapy, 65*(2), 133-142.

# Comprehensive Evaluation

- Historical information
  - Medical and developmental history
  - Description of educational & therapeutic services
- Exploration of connection between reason for referral and underlying sensory and motor functions
- Assessment of sensory and motor functions
  - Sensory modulation
    - Hyper-responsivity
    - Hypo-responsivity
  - Sensorimotor integration
    - Postural Control
    - Praxis

Parham, L. D., Cohn, E. S., Spitzer, S., Koomar, J. A., Miller, L. J., Burke, J. P., . . . Smith Roley, S. (2007). Fidelity in sensory integration intervention research. *American Journal of Occupational Therapy, 61*(2), 216-227.; Parham, L. D., Roley, S. S., May-Benson, T. A., Koomar, J., Brett-Green, B., Burke, J. P., . . . Schaaf, R. C. (2011). Development of a fidelity measure for research on the effectiveness of the Ayres sensory integration intervention. *The American Journal of Occupational Therapy, 65*(2), 133-142.

# Evaluation Tools

- Interview to ascertain parent/caregiver and teacher concerns
- Completion of a sensory history
  - Sensory Processing Measure (Parham, Ecker, Miller Kuhaneck, Henry, & Glennon, 2007)
  - Sensory Profile (Brown & Dunn, 2002)
- Evaluation of sensory & motor Skills
  - Sensory Integration & Praxis Tests (Ayres, 1989) – Gold Standard
  - Bruininks Oserestsky Test of Motor Performance – 2nd Edition
- Evaluation of Adaptive Behavior Skills
  - Vineland Adaptive Behavior Scale

# Sensory Integration Therapy

*A procedure is therapeutic if it enables a child to make a response to his environmental input that is more adaptive (mature) than previous responses. Otherwise, activity is simply exercise.*


Ayres, A. J. (1975) Sensorimotor foundations of academic ability. In Cruckshank, W.M. and Hallahan, D.P. (Eds.) *Perceptual and Learning Disabilities in Children, Vol.2*. New York: Syracuse University Press.

# Structural Core Elements

- Therapist Qualifications
- Comprehensive Evaluation
- Development of Relevant Functional Outcomes
- Preparation for Intervention
  - Physical environment
  - Access to sensory-based equipment
- Ongoing communication about intervention process

Parham, L. D., Cohn, E. S., Spitzer, S., Koomar, J. A., Miller, L. J., Burke, J. P., . . . Smith Roley, S. (2007). Fidelity in sensory integration intervention research. *American Journal of Occupational Therapy, 61*(2), 216-227.; Parham, L. D., Roley, S. S., May-Benson, T. A., Koomar, J., Brett-Green, B., Burke, J. P., . . . Schaaf, R. C. (2011). Development of a fidelity measure for research on the effectiveness of the Ayres sensory integration intervention. *The American Journal of Occupational Therapy, 65*(2), 133-142.

# 10 Process-Related Core Elements

- Ensures Physical safety
- Presents Sensory Opportunities - at least two of three of the following: vestibular, proprioceptive and tactile
- Supports optimal alertness & affect
- Challenges postural, ocular, oral, or bilateral motor control
- Challenges praxis and organization of behavior
- Collaborates with child in activity choice
- Tailors activity to present the just-right challenge
- Ensures activities are successful
- Supports child's intrinsic motivation to play
- Establishes a therapeutic alliance

Parham, L. D., Cohn, E. S., Spitzer, S., Koomar, J. A., Miller, L. J., Burke, J. P., . . . Smith Roley, S. (2007). Fidelity in sensory integration intervention research. *American Journal of Occupational Therapy, 61*(2), 216-227.; Parham, L. D., Roley, S. S., May-Benson, T. A., Koomar, J., Brett-Green, B., Burke, J. P., . . . Schaaf, R. C. (2011). Development of a fidelity measure for research on the effectiveness of the Ayres sensory integration intervention. *The American Journal of Occupational Therapy, 65*(2), 133-142.