

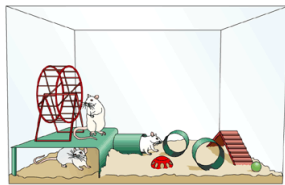
Sensory Enrichment Therapy as an Effective Treatment for Autism

Michael Leon, Ph.D.
Center for Autism Research and Treatment
Department of Neurobiology and Behavior
University of California Irvine

Further decreasing environmental stimulation

- Increases cell death
- Decreases production of new neurons
- Interferes with neuronal pathfinding
- Induces functional impairments

Increasing environmental stimulation



Increased stimulation enhances brain function

- Increases growth factors
- Increases connections between neurons
- Increases production of new neurons
- Improves learning

Enriched environments improve outcomes after neural challenges

- | | |
|---------------------------|----------------------------|
| • Stroke | • Huntington's disease |
| • Seizures | • Parkinson's disease |
| • Brain lesions | • Alzheimer's disease |
| • Percussive head injury | • Down syndrome |
| • Neural transplants | • ALS |
| • Neuronal death in aging | • Cerebellar degeneration |
| • ADHD | • Repetitive behavior* |
| • Prenatal alcohol | • Fragile X syndrome* |
| • Lead exposure | • Rhett syndrome* |
| • Valproic acid* | • Potocki-Lupski syndrome* |

Can this approach be used in humans?

Further decreasing brain activation



One third of orphanage children have post-institutional autistic syndrome

- Inference of other's intentions
- Attention
- Social interactions
- Language production
- Response to language
- Memory formation
- Motivation
- *Reversed with high-quality foster care*

Brain areas affected in autism

- **medial prefrontal cortex** infers other's intentions
- **cerebellum** attention
- **insular cortex** language response
- **orbitofrontal cortex** social judgment
- **supramarginal gyrus** language production
- **hippocampus** memories
- **nucleus accumbens** motivation
- **fusiform gyrus** facial recognition

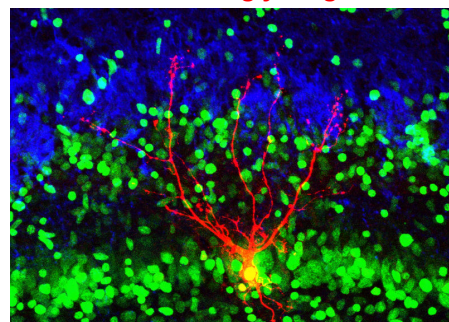
Human brain areas affected by olfactory loss

- **medial prefrontal cortex**
- **cerebellum**
- **insular cortex**
- **orbitofrontal cortex**
- **supramarginal gyrus**
- **hippocampus**
- **nucleus accumbens**
- **fusiform gyrus**

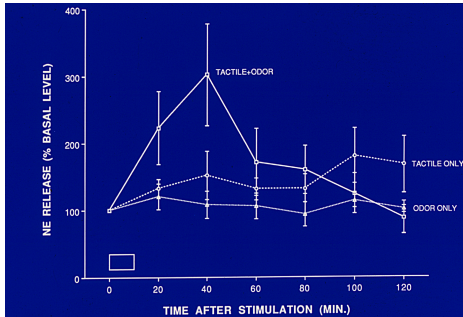
Olfactory and tactile sensitivity in autism

- More than 90% of children with autism have sensory differences from typical children.
- Olfactory and tactile dysfunction are the strongest predictors of atypical social behaviors and poor social communication.

Olfactory/tactile pairings induce learning young rats



Increasing olfactory/tactile stimulation



Increased olfactory and/or tactile stimulation

- Infants learn to prefer the mother's odor or other odors that are paired with tactile stimulation.
- The learned odor calms distressed infants.
- Olfactory stimulation prevents apnea and bradycardia in infants.
- Tactile stimulation increases weight gain of premature infants.
- Odor + tactile stimulation has an even greater impact on the growth of premature infants.

Mothers give their children a daily massage with a scented oil



Can olfactory/tactile stimulation ameliorate the symptoms of autism?

Environmental enrichment for a 3-year-old female with autism

- Poor language skills
- Poor cognitive skills
- Poor motor skills
- Poor social skills
- Repetitive behavior

Sensory Enrichment Therapy

- Olfactory stimulation four times/day, paired with gentle tactile stimulation.
- Olfactory stimulation through the night.
- Sensory stimulation games, morning and evening, each time for 15-30 min.
- Emphasis on novelty.

Clinical trial

- 'Gold standard' test confirmed the diagnosis of 'full' autism (ADOS)
- Random assignment to Sensory Enrichment Therapy or Standard Care
- IQ test (Leiter), autism severity test (CARS)
- Tested blind at the start of the study and after 6 months

Subject characteristics

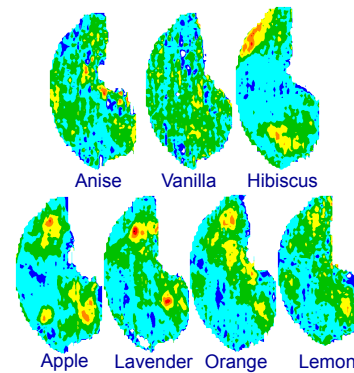
No difference in:

- gender (all boys)
- age (3-12 years old)
- initial cognitive scores
- initial severity of autism symptoms

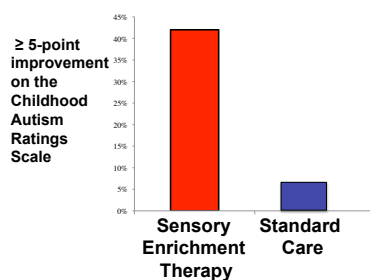
No significant difference in concurrent therapies

	Standard Care	Sensory Enrichment
Speech therapy	80%	77%
Occupational therapy	60%	54%
Applied behavioral analysis	67%	77%
Social skills	13%	8%
Adapted physical education, physical therapy, other.	53%	31%

Odorant stimuli



42% of children with autism had a clinically significant improvement



Paired sensorimotor exercises

- The child places his/her hands or feet in water of different temperatures (thermal, motor)
- The child squeezes objects of different shapes and textures (tactile, motor)
- The parent draws lines on the child's hand with objects of different texture while the child watches (tactile, visual)
- The blindfolded child walks on a pathway of different textures (tactile, motor)
- The parent draws imaginary lines on the child's face, arms, and legs with objects having different textures while music plays (tactile, auditory)
- The child selects the twin of objects in a pillowcase after seeing it on the table (tactile, cognitive)
- The child is given a scented bath and a massage with scented oil (thermal, tactile, olfactory)
- The parent touches the child on his/her arms and legs with a cooled spoon or warmed spoon while the parent speaks or sings (thermal, auditory, tactile)

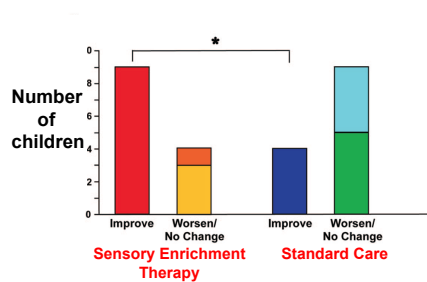
Paired sensorimotor exercises

- The child selects a texture square that matches the texture of an object in a photo (tactile, cognitive, visual)
- Different objects are used to draw imaginary circles on the child's face (tactile, cognitive)
- The child places cold straws filled with ice in Play-Doh using each hand (motor, thermal, visual)
- The child walks on a 2' x 8" x 5' board while holding a cooled tray (thermal, balance, motor)
- The parent rubs each of the child's fingers and toes in turn, while the child watches (tactile, visual)
- The child places coins in a piggy bank using only his/her reflection in a mirror (motor, cognitive, visual)
- The child uses a magnet on the end of a small fishing line to pick up paper clips (motor, visual)
- The child tracks a red object that is moved around a photo of a painting (visual, cognitive)

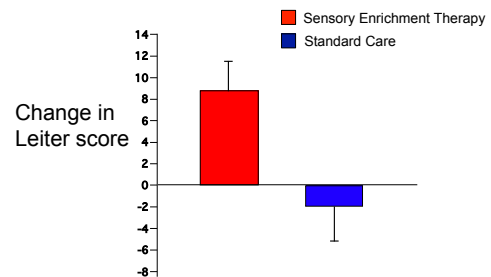
Paired sensorimotor exercises

- The child draws shapes using pen and paper while the parent draws imaginary shapes on the child's back using a toy (motor, tactile, visual)
- The child walks up and down stairs while holding a big ball or pillow (motor, tactile, balance)
- The child draws lines using both hands simultaneously (motor, visual)
- The child matches the color of objects in a photo with color beads (visual, cognitive, motor)
- The child is shown a picture of an object and picks out the real object on a table among other objects (visual, cognitive, motor)
- The child blows a small piece of aluminum foil on the floor as far as possible (motor, visual)
- The child views a picture moving with another picture (visual, cognitive)
- The child views a photo and music regarding a scene (auditory, visual)
- Classical music at bedtime
- Lines are drawn on the child's arms and legs with cooled or warmed spoons (thermal, tactile)

69% of parents saw improvement with Sensory Enrichment Therapy



10.7 point difference on a cognitive test



Communication improvements

"She continues to amaze us with her language."
 "She is talking a lot and is referring to her friends/teachers at school."
 "I am seeing improvement in his conversational skills."
 "She continues to show an increase in her vocabulary."
 "The teacher informed me how his language has been improving."
 "She is talking a lot and using new words all the time."
 "He is progressing really well with his language development."
 "His vocabulary has increased and his articulation has improved."

Prolonged therapy

- Seizures at 2.5 years-old, minimally verbal, non- interactive
- Standard treatment until 8 years-old with only minor improvement
- Sensory Enrichment Therapy with no other treatments for 18 months

Enriched environments improve outcomes after neural challenges

- Stroke
- Seizures
- Brain lesions
- Percussive head injury
- Neural transplants
- Neuronal death in aging
- **ADHD**
- Prenatal alcohol
- Lead exposure
- Valproic acid*
- Huntington's disease
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- Repetitive behavior*
- Fragile X syndrome*
- Rhett syndrome*
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Advantages of this treatment

- Effectiveness
- Expertise
- Expense
- Extends the age for effective treatment

It's not sensory integration therapy

• Sensory integration therapy is widely used for the treatment of autism, but there is little high-quality data that support its use (Baranak, 2002; Dawson and Watling 2000).

• "...parents should be informed that the amount of research regarding the effectiveness of sensory integration therapy is limited and inconclusive."

American Academy of Pediatrics, 2012

It's not sensory integration therapy

• A small, but significant decrease in "autistic mannerisms" [SRS subscale] in a sensory integration group compared to controls (Pfeiffer, et al., 2011).

Sensory Integration vs. Sensory Enrichment

- No exercise balls, swings, beanbags, trampolines, vibrating, brushing, weighted vests or blankets, deep pressure, pillows, chewing, vestibular stimulation, heavy work, rocking, tunnels, unpaired sensory stimulation
- Very few proprioceptive exercises in Sensory Enrichment Therapy
- Several times/day (Sensory Enrichment) vs. 1-3 times/week (Sensory Integration)

Additional questions

- Can it last?
- Can we predict who will improve?
- Can continued therapy improve outcomes?
- Can it work alone?
- Can it be replicated in other clinics?
- Can it work for older or younger children?
- Can it work for medicated children?
- Can we optimize outcomes?
- Can we characterize the changes in the brain?

Treatment guidance

- Woo, C.C. and Leon, M. 2013. Environmental enrichment as an effective treatment for autism: A randomized controlled trial. *Behavioral Neuroscience*, 127:487-497.

- Mendability.com

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