Systems biology of autism told through stories of people who got a lot better:

**The Autism Revolution:**

*Whole Body Strategies for Making Life All It Can Be*


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“LEGO” Modular Model:
Gene 🔄 Brain 🔄 Behavior
Determined before birth, fixed for life
Nothing you can do

AUTISM

- Communication
- Social Interaction
- Restricted Behaviors

COMMUNICATION
SOCIALIZATION
BEHAVIOR
New model – an Autism Revolution: From genetic brain impairment to environmental, medical obstruction of brain function

Not just genetic:
- Hundreds of genes, most modest impact
- Numbers going up
- Evidence for environmental factors

Not just brain:
- Systemic features – Whole Body
- Environmentally vulnerable physiology

Not just brain modules:
- Whole brain involvement
- Brain tissue changes

Not necessarily hardwired:
- Plasticity and recovery
Gene $\rightarrow$ Brain $\rightarrow$ Behavior model

- Genetics
- Drugs

Communication
Social interaction
Restricted behavior

Behavior Therapy
Whole Body Systems Model: Vicious circles in brain and body

Psycho-Social Environment

Physical environment

Genetics

Cellular Dysfunction: Energy, Signaling, Metabolism

Brain

Body

Communication
Social interaction
Restricted behavior

Sensory
Sleep
Seizures

Gastro
Immune
Hormones etc.

Frustration

More easily OVERWHELMED

Pain,
Poor function
Sickness

Overload!
STRESS!
Autism’s Symptoms Emerge from Problems with Underlying Functions

VISIBLE Social & Behavioral SYMPTOMS

UNDERLYING SYSTEMIC FUNCTIONAL DISTURBANCES

Ziggarut model: http://www.texasautism.com/
Reduce *Total Load* of Stressors to get Better Health, that will give Brains more “Bandwidth”

- **Poor Bandwidth:** Limited Reception
- **Lots of Bandwidth:** Good Reception

**Better Reception Allows Better Discernment of Differences and More Spontaneous Learning**
Is autism is really a hard-wired defect?

Research and clinical observations suggest otherwise:

• Published transient improvement with fever
  – Reports of improvement under various other circumstances
• Documented recovery / remission in some cases
• Reversal of symptoms in autism-relevant animal models

HOW CAN THE BRAIN IMPROVE LIKE THIS?

WHAT IS THIS TELLING US ABOUT AUTISM??

Hypothesis: ASD is

→ Not fixed but changeable
→ Not a STATIC but a DYNAMIC encephalopathy
Rapid IMPROVEMENT in brain connectivity suggests autism may be “state,” not “trait”

- Functional connectivity changed rapidly with drug that impacts brain stress level (propranolol)
- Most research assumes it is a fixed trait
- Could other interventions reducing total load also decrease stress and improve brain function?

**Effect of Propranolol on Functional Connectivity in Autism Spectrum Disorder—A Pilot Study**
Narayanan et al. (Beversdorf lab)
*Brain Imaging and Behavior, 2010*
More than “genetically altered wiring diagram”: Brain tissue shows signs of immune activation or “neuroinflammation.”

**Neuroglial activation and neuroinflammation in the brain of patients with autism**

Vargas et al, 2005, Annals of Neurology

**Oxidative stress in brain tissues from autistic patients**

Vargas et al, 2005, Annals of Neurology

**ACTIVATED GLIAL CELLS**
- Activated ASTROGLIAL cells (astrocytes)
- Activated MICROGLIAL CELLS
Brain cells in inflammation

- Excitatory chemicals created by activated glial cells
- Normal housekeeping and communication functions of glial cells get neglected or overwhelmed
- Glial cells are the brain’s “garbage collectors” so trash and debris pile up
- Chronic inflammation can cause damage
- Chronic inflammation is irritating and promotes excitotoxicity
- Early immune problems can alter development

Inflammation and Its Discontents: The Role of Cytokines in the Pathophysiology of Major Depression.
Miller et al., BIOL PSYCHIATRY 2009;65:732–741
Full text available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2680424/?tool=pubmed
Air Pollution and Brain Inflammation
Block and Calderon-Gardicuenas, Trends in Neuroscience, 2009

Air pollution already linked to autism (e.g. Palmer 2006; Windham 2006; Volk 2011)
Environmental Stressors are contributing to an **ONGOING, CHRONIC** DEGRADATION OF BRAIN AND BODY FUNCTION

Model of autism: Increased ratio of excitation / inhibition in key neural systems


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**Too Much Excitation**  
**Not Enough Inhibition**

=  

**More:** irritability, hypersensitivity, overload

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**Reduced informational complexity and organization**

**Reduced signal to noise ratio**

**Increased chaos and confusion**

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This excitation/inhibition ratio can be increased by inflammation, oxidative stress and toxicants, as well as genetic dysfunction
“Inefficiency” in brain signaling in autism

J.R. Isler, K.M. Martien, P.G. Grieve, R.I. Stark, M.R. Herbert

Clinical Neurophysiology 121 (2010) 2035–2043

ASD has more power than controls... but less coherence

Too much noise, not enough signal

BETTER BANDWIDTH SHOULD IMPROVE THIS
“Wild-type microglia arrest pathology in a mouse model of Rett syndrome”

- Rett features had been attributed to neuronal dysfunction
- Astroglial cells now known to contribute
- Now microglia shown to contribute as well: bone marrow transplant of wild type microglia
  - Increased lifespan, normalized breathing, increased body weight, improved locomotor activity
  - Improvement even without direct change to neurons
  - Improvements lost when microglial phagocytic (garbage-collecting) activity inhibited
ABOUT GLIAL CELLS

A top glial scientist explains to the public how glial cells are revolutionizing medicine and science

www.TheOtherBrainBook.com
A Different Model of Autism: Autism as an emergent property of a system with altered parameters

- Autism is not just a “developmental disorder” that’s hardwired into the brain before you’re born
- Autism is created moment by moment by how the cells in the brain function
- The cells of the brain function differently depending on their health
- The health of brain cells depends on the health of the whole body – and on the health of the earth

Herbert, 2009, “Autism: The centrality of pathophysiology and the shift from static to dynamic encephalopathy” In Chauhan et al, Autism: Oxidative stress, inflammation and immune abnormalities
RECIPE for improvement: The basis for an AGGRESSIVE PUBLIC HEALTH PROGRAM

POOR BANDWIDTH, LOTS OF CHAOS

• Poor food: few nutrients, many allergens
• Lots of toxins and infectious issues
• Lots of stress, pressure, too much too fast

GOOD BANDWIDTH, RICH ORGANIZATION

• Excellent food: high nutrient density, minimal allergens
• Minimal toxic and infectious burden
• Love, learning, respect, sensitive sensory input, savor each moment
The Autism Revolution: Whole Body Strategies for Making Life All It Can Be

We all need an AUTISM REVOLUTION.

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