Environmental Biodynamics:
Rethinking the Role of *Time* in Environmental Health Research

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“The more I feel an American, the more this situation pains me. I can escape the feeling of complicity in it only by speaking out” - Albert Einstein
Latency and Time

Disease detected

origins

JGregory ©2015 Mount Sinai Health System
But, what is *time*?

Change with time (i.e. aging)

No change. Where is *time*?
Two aspects of time

Loss of sequential order

Uneven intervals

We prioritize the sequential order over the interval
'omics and Environmental Biodynamics

[Bar chart with bars for Intensity and Concentration labeled as -omic]
'omics and Environmental Biodynamics

Intensity - Concentration

Substance-based disorganized complexity

Orbits - Trajectories

Environmental Biodynamics

Process-based organized complexity
What were you exposed to at birth or in early childhood?
Studies on autism spectrum disorder

*Centers for Disease Control and Prevention (CDC) prevalence estimates are for 4 years prior to the report date (e.g., 2018 figures are from 2014)*
Early Diagnosis. Why?

Source: Neurons to Neighborhoods (2000)
Parent-mediated social communication therapy for young children with autism (PACT): long-term follow-up of a randomised controlled trial

*Lancet* 2016; 388: 2501-09

Andrew Pickles, Ann Le Couteur, Kathy Leadbetter, Erica Salomone, Rachel Cole-Fletcher, Hannah Tobin, Isobel Gammer, Jessica Lowry, George Vamvakas, Sarah Byford, Catherine Aldred, Vicky Slonims, Helen McConachie, Patricia Howlin, Jeremy R Parr, Tony Charman, Jonathan Green

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Randomized, Controlled Trial of an Intervention for Toddlers With Autism: The Early Start Denver Model

*Early Start Denver Model*
>90% accurate biomarker operationalized within first 6 months of life

Discovery population: RATSS, Sweden
Replication: Texas, USA, New York, USA, and UK

Nature Communications, 2017, 8:15493
Science Advances, 2018, 4 (5): eaat1293
Translational Psychiatry, 2019, 9: 238

Financial conflict of interest: Mount Sinai patent applications
Elemental biodynamics and autism risk

Complexity of the orbits

Sweden

- controls
- cases

N = 193

Data are from prenatal period and first 6 months postnatally
Elemental biodynamics and autism risk

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Complexity of the orbits

Sweden  US-NY  US-TX

controls  cases

N = 193

Data are from prenatal period and first 6 months postnatally
Elemental biodynamics and autism risk

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N = 193
Elemental biodynamics and autism risk

Complexity of the orbits

Sweden  US-NY  US-TX  UK  Pooled

Data are from prenatal period and first 6 months postnatally

N = 193

controls cases
Hair biomarkers (~300 features)
Classifier accuracy for ASD

AUC: 0.947 (0.875–1.000)

Data are on hair
Beyond autism

ALS, Lou Gherig’s Disease
(after 50 years)

ASD/ADHD
(teenage to early 20 years)

Psychosis
(teenage to early 20 years)

Other disorders:
IBD
Parkinson’s
Kidney transplant rejection

Data are on teeth
ALS, Lou Gehrig’s Disease
ALS

- Much of the etiology of sporadic ALS remains unknown
- Both genetic and environmental factors are important
- Early life environmental factors are suspected but remain unknown

Claudia Figueroa-Romero PhD
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ALS

• At average age of 60, we reconstruct weekly measures of exposure to essential elements and toxic metals using teeth.

• The data shown next is from birth to 15 years.

• 36 cases and 31 controls, age and gender matched.
ALS Results

ALS Results

Summary

• If we are to overcome challenges in studying latency between risk factors and disease, we need to rethink the role of *time* in environmental health studies.

• Prospective cohort sampling is not the same as environmental biodynamics.

• Collect baby and adult teeth and hair in your studies.
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