

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

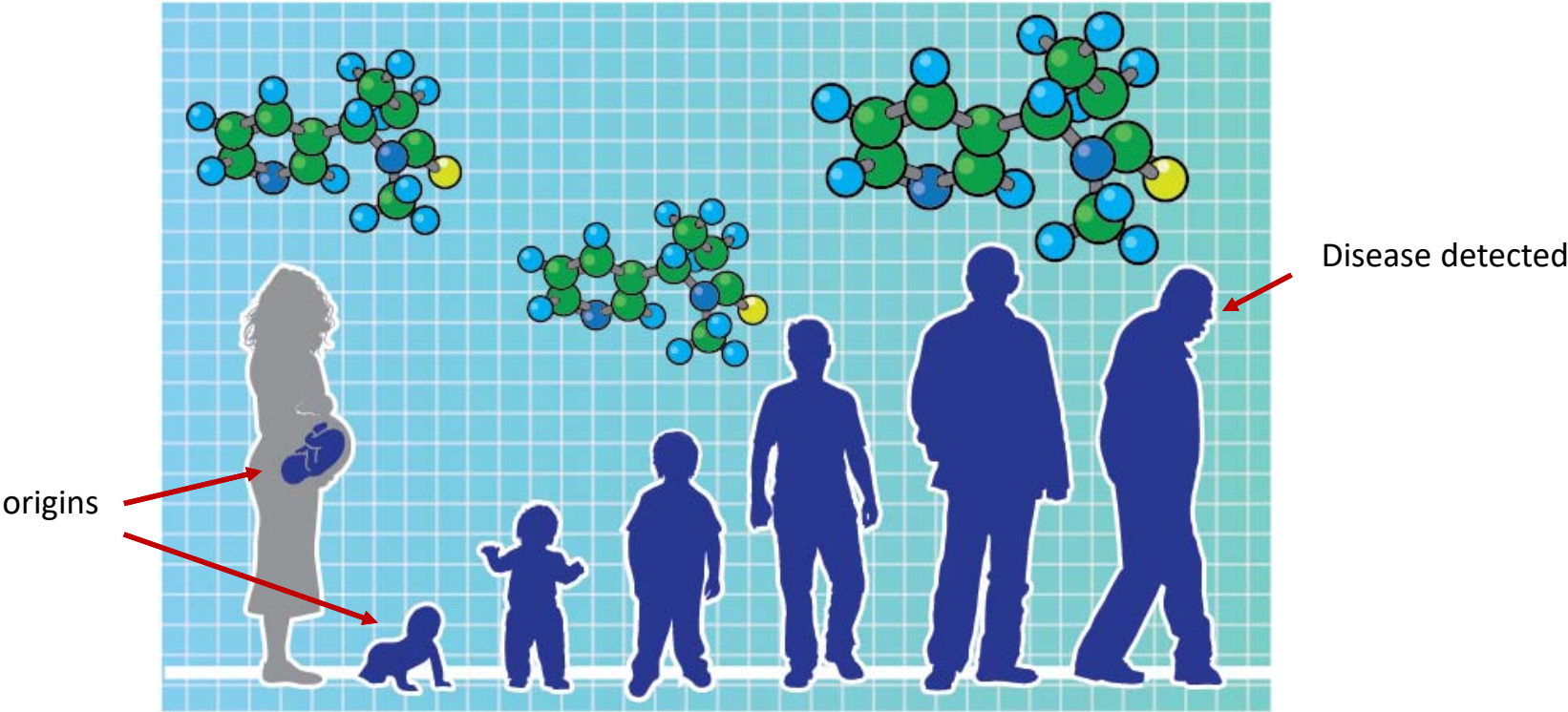
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\*Edith J. Baerwald Professor and Vice Chair  
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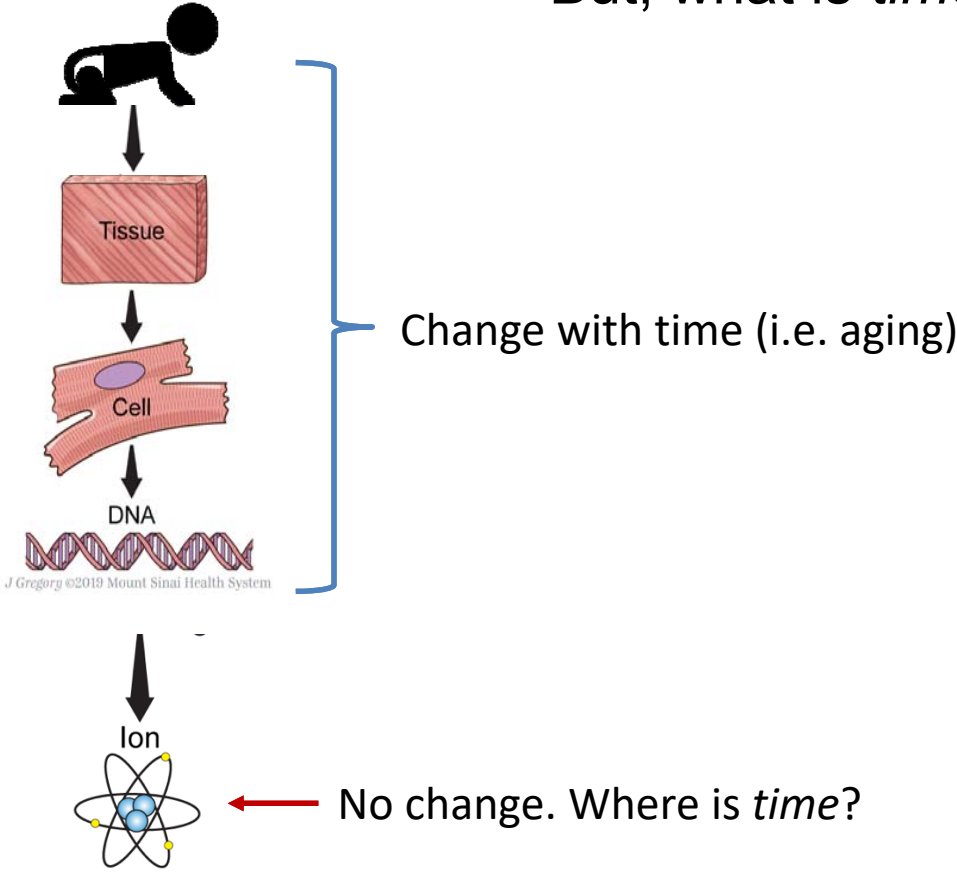
“The more I feel an American, the more this situation pains me. I can escape the feeling of complicity in it only by speaking out” - *Albert Einstein*

# Latency and Time

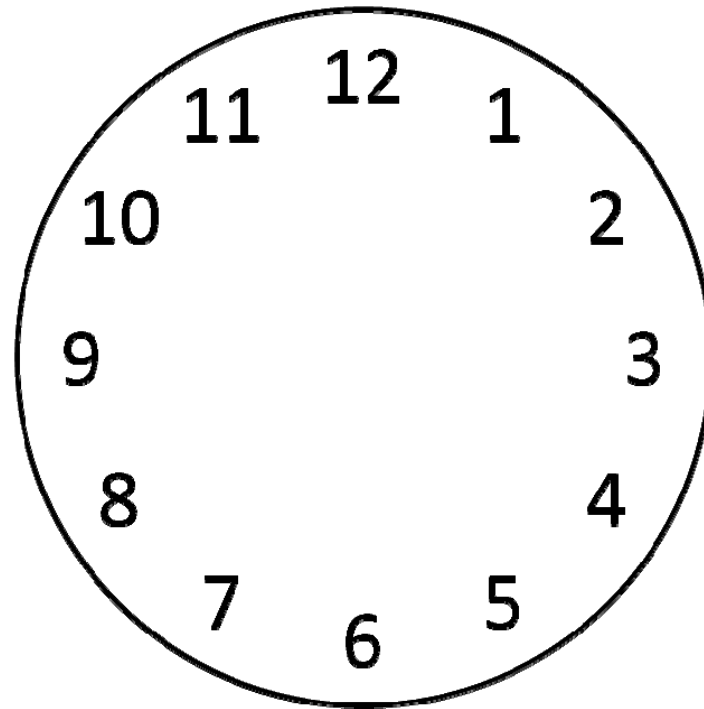


JGregory ©2015 Mount Sinai Health System

But, what is *time*?



Time



## Two aspects of time

1 7 3 10 5 6 9 4 11 2 8 12

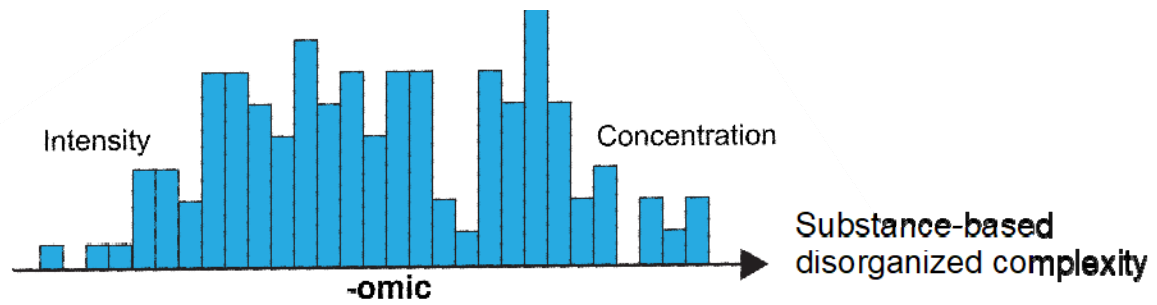
*Loss of sequential order*

1 2 3 4 5 6 7 8 9 10 11 12

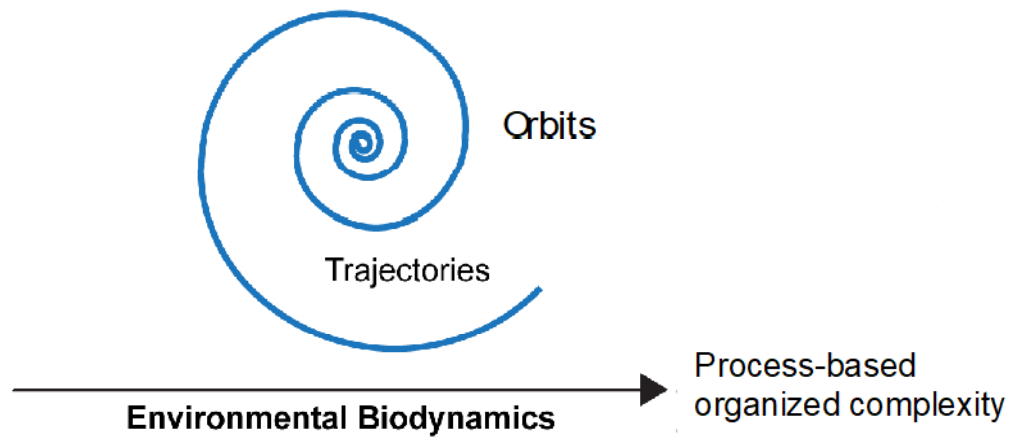
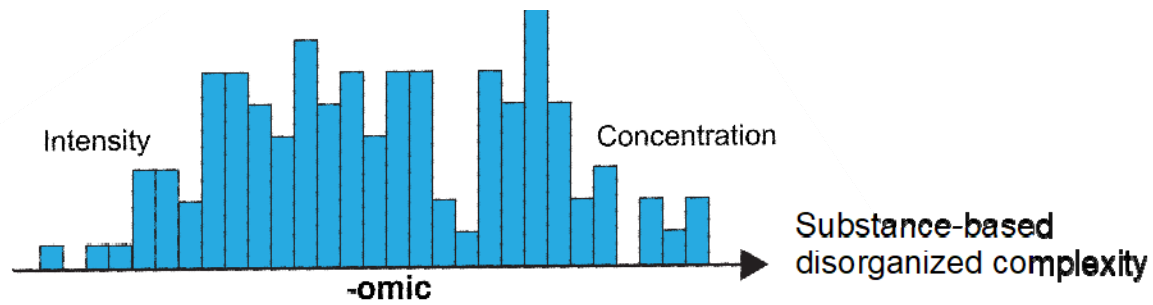
*Uneven intervals*

We prioritize the sequential order over the interval

## 'omics and Environmental Biodynamics

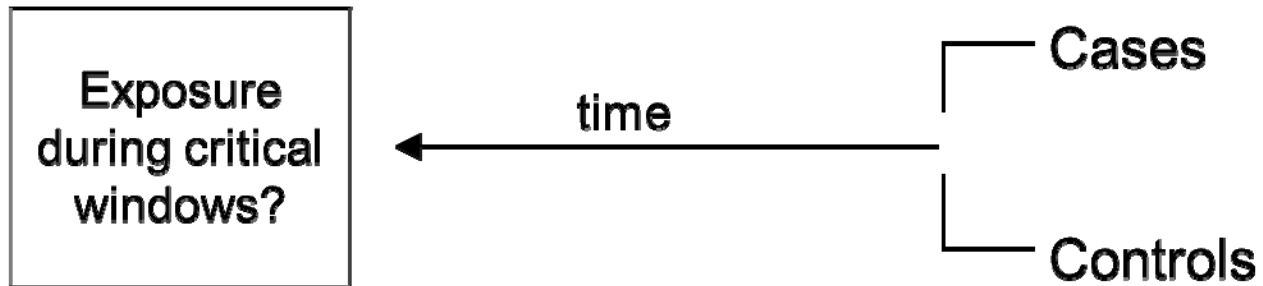


# 'omics and Environmental Biodynamics





## Environmental Biodynamics and Critical Windows

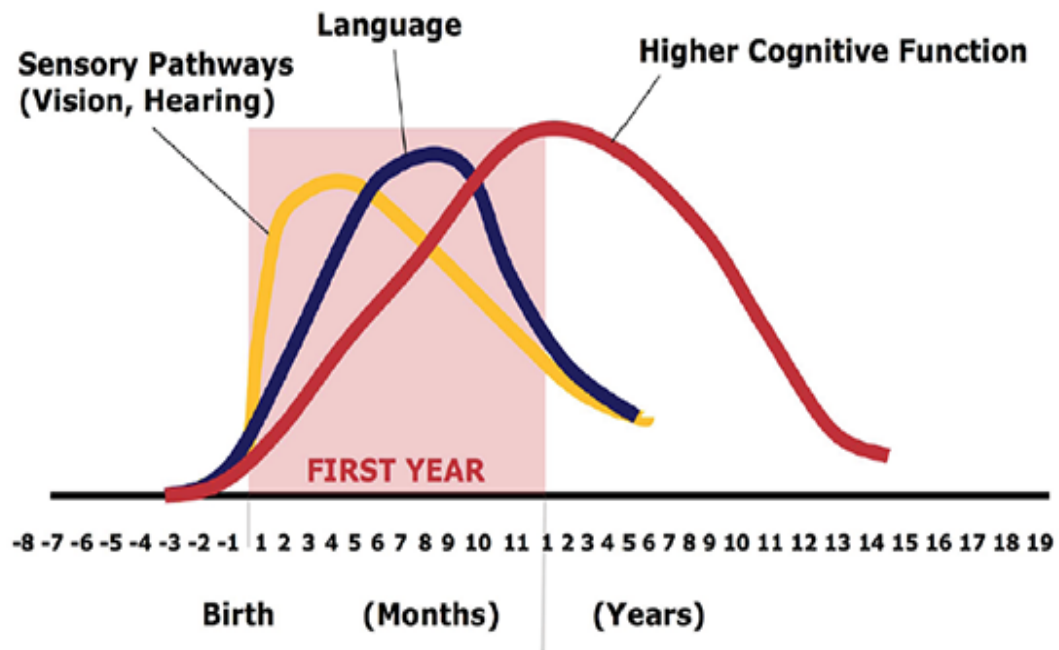


*What were you exposed to at birth or in early childhood?*

## Studies on autism spectrum disorder



## Early Diagnosis. Why?



Source: *Neurons to Neighborhoods* (2000)

Early Diagnosis = Early Intervention = Better Outcomes

**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 Leadbitter, 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*

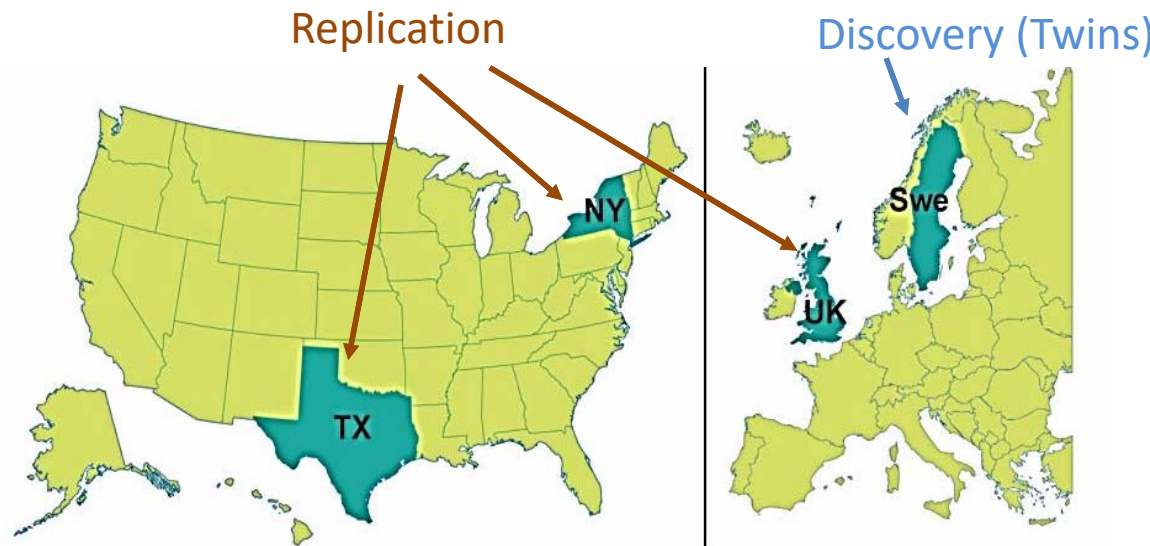
**PEDIATRICS**<sup>®</sup>

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

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

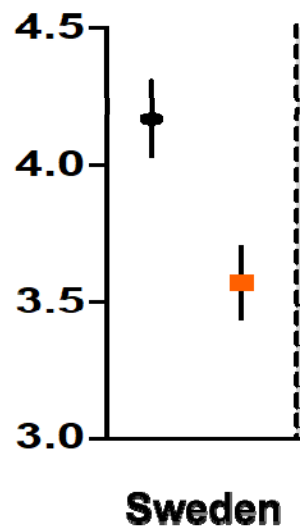
Nature Communications, 2017, 8:15493  
Science Advances, 2018, 4 (5): eaat1293  
Translational Psychiatry, 2019, 9: 238



Financial conflict of interest: Mount Sinai patent applications

## Elemental biodynamics and autism risk

Complexity of the orbits

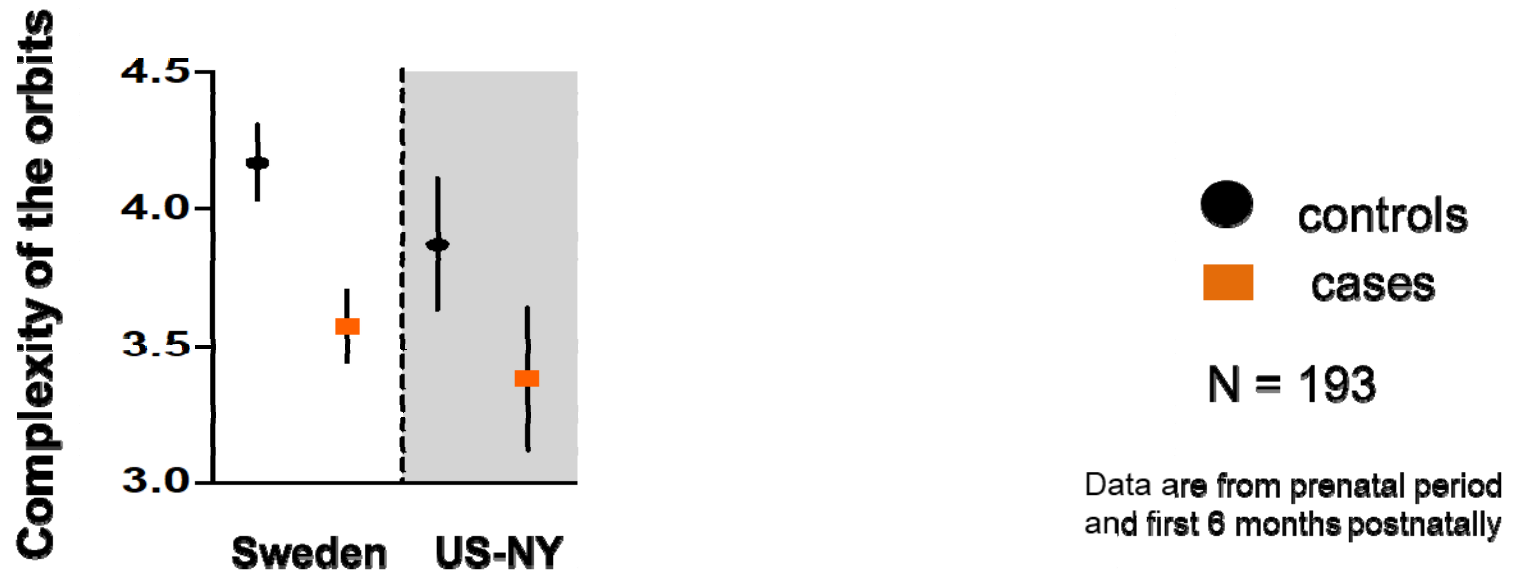


● controls  
■ cases

N = 193

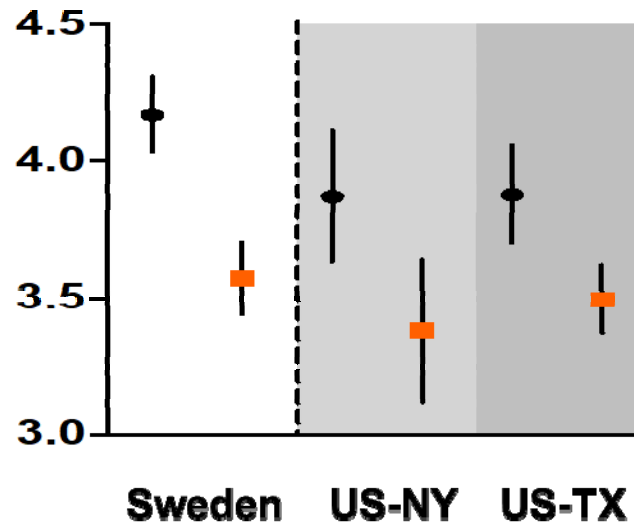
Data are from prenatal period  
and first 6 months postnatally

## Elemental biodynamics and autism risk



## Elemental biodynamics and autism risk

Complexity of the orbits



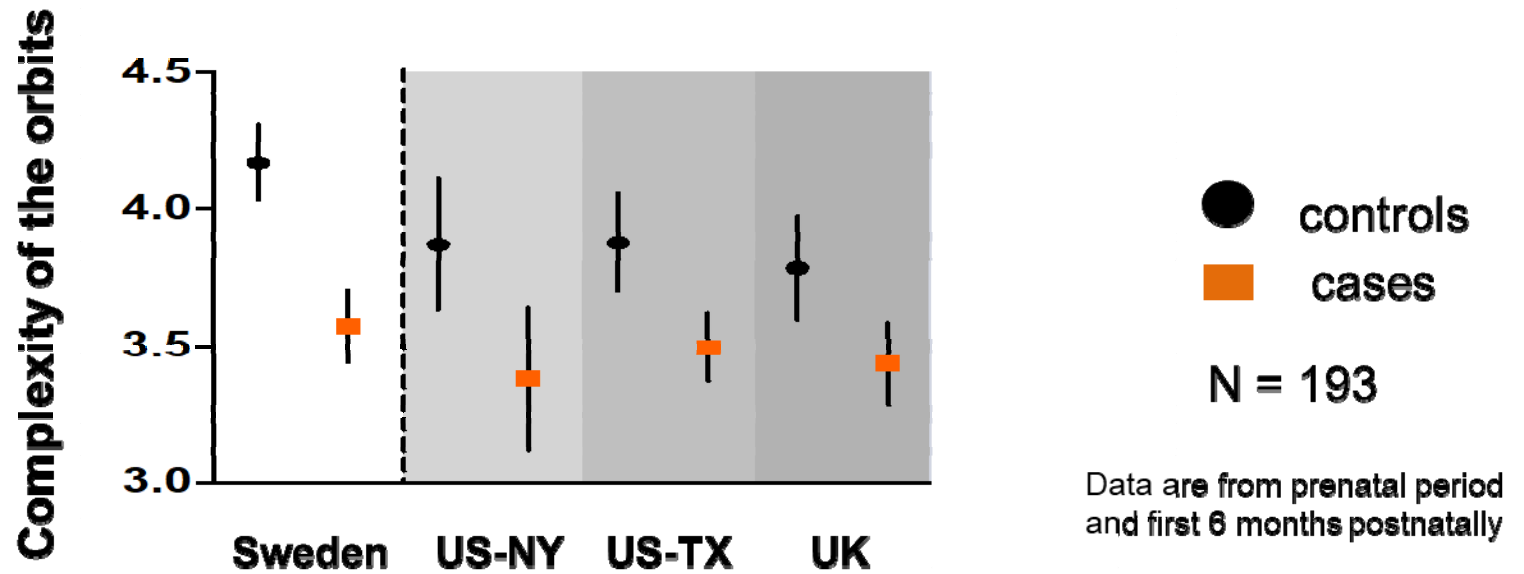
● controls  
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N = 193

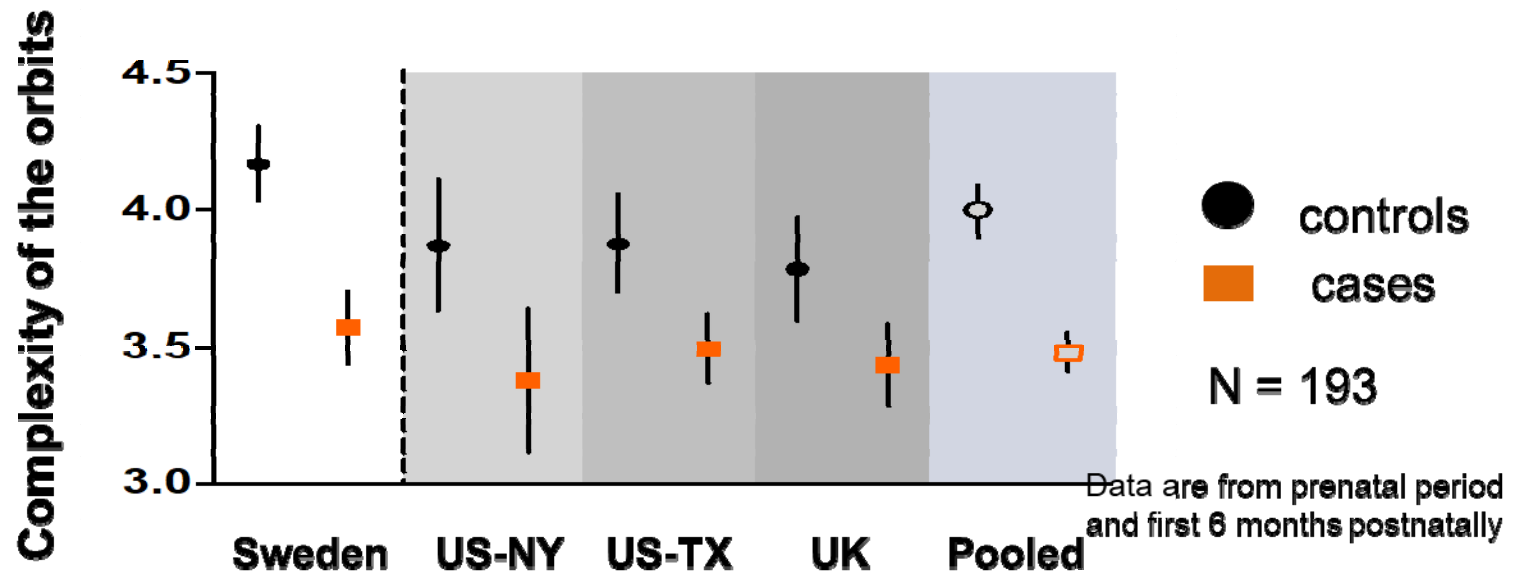
Data are from prenatal period  
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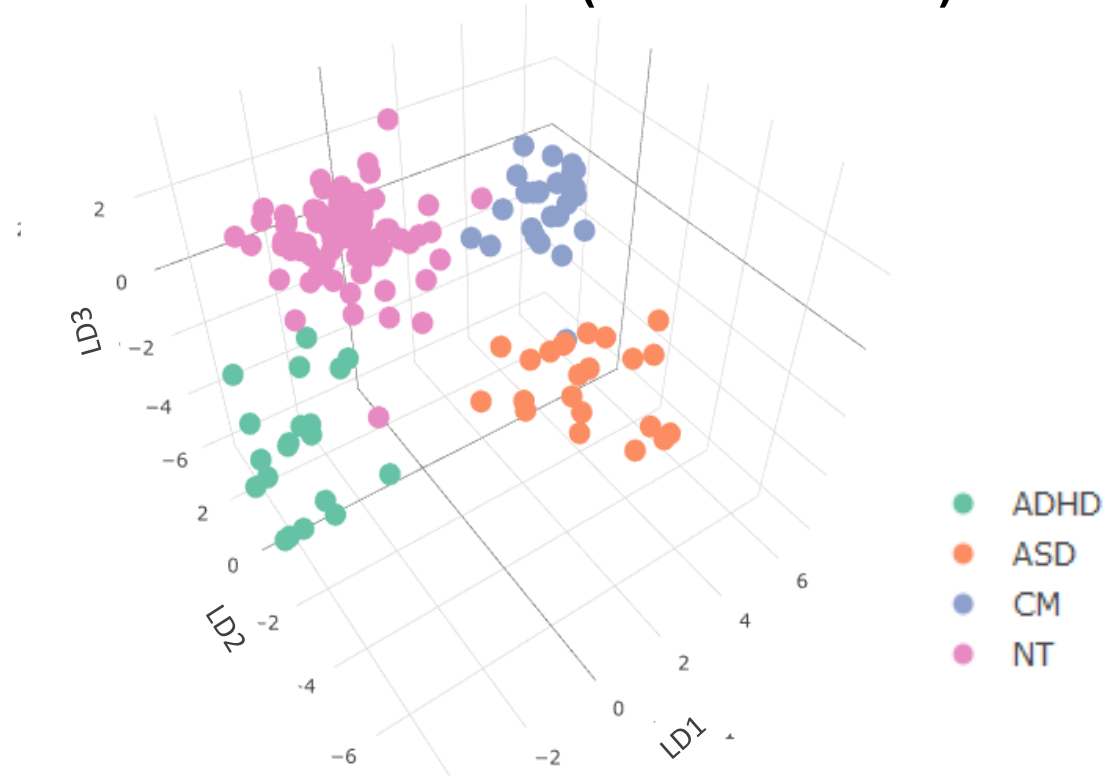
## Elemental biodynamics and autism risk



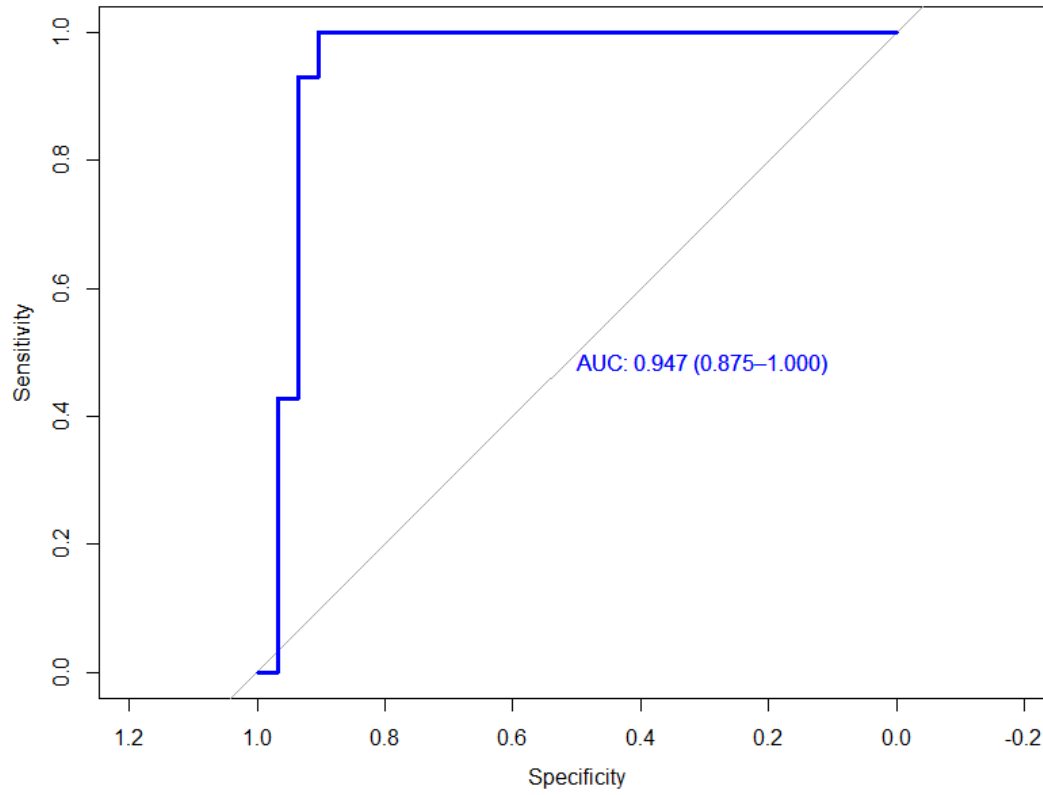
## Elemental biodynamics and autism risk



## Hair biomarkers (~300 features)

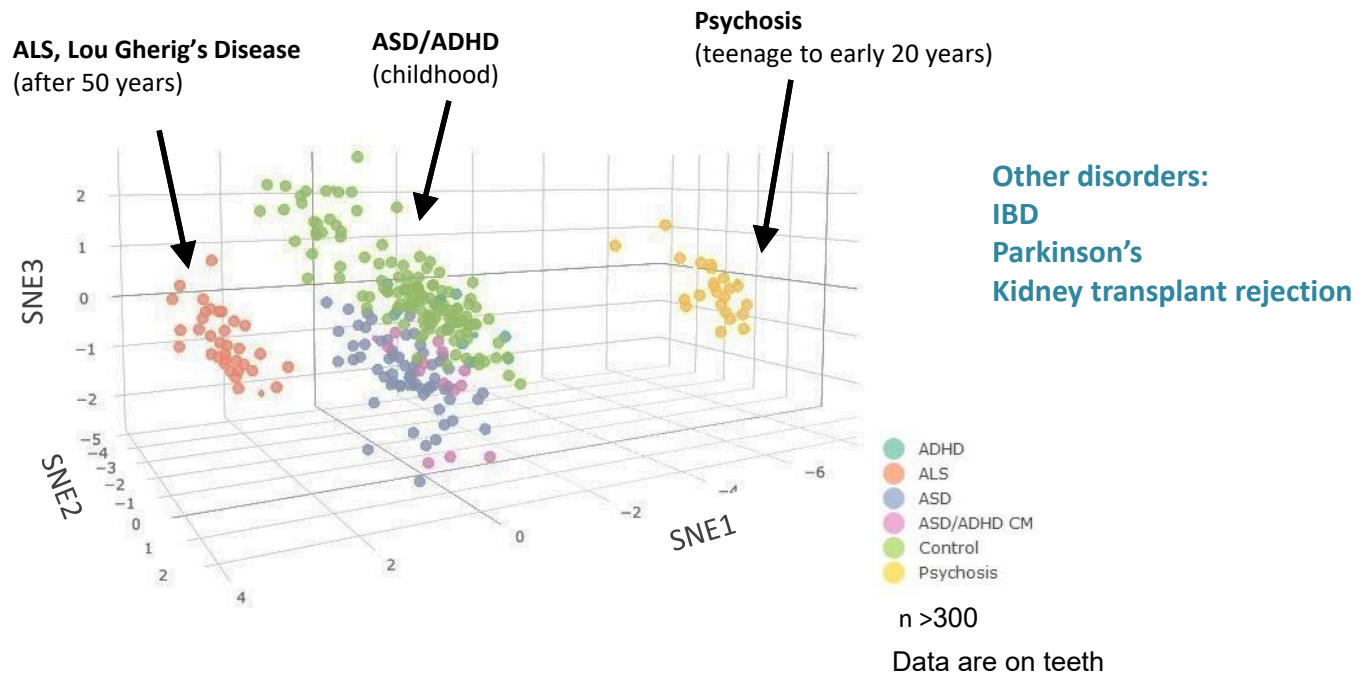


# Classifier accuracy for ASD

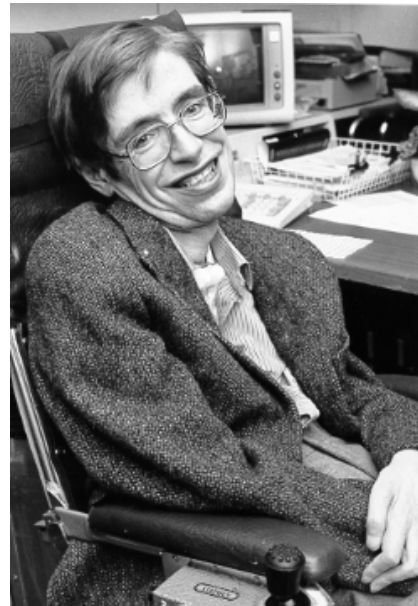
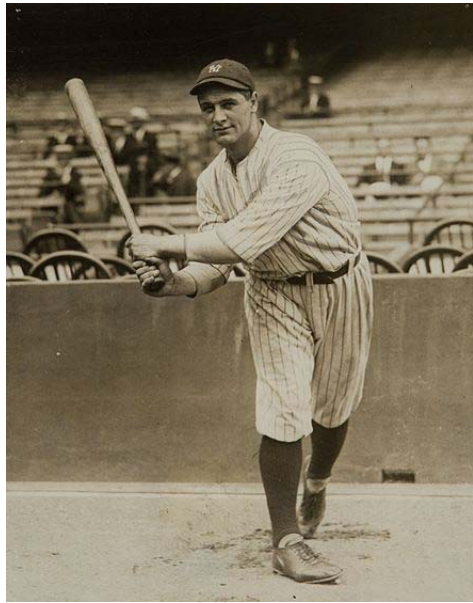


Data are on hair

# Beyond autism



## 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



Stephen Goutman MD, MS

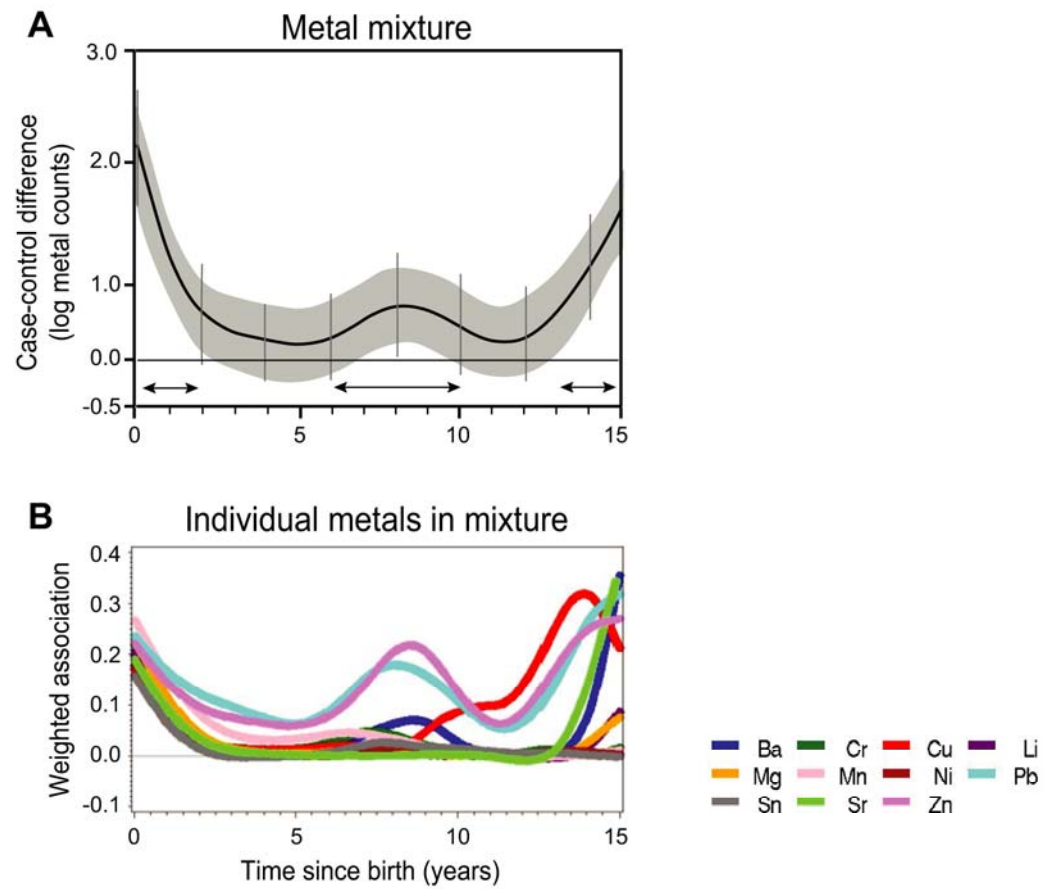
University of Michigan

## 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.

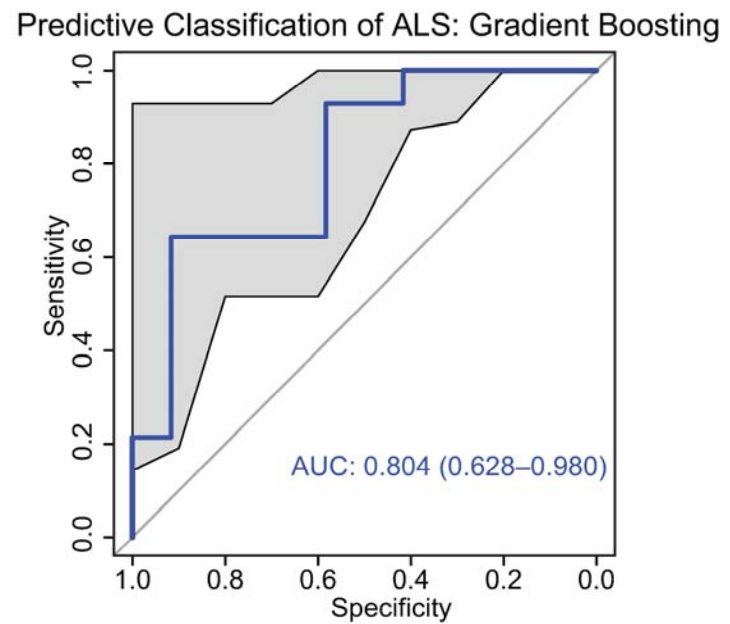
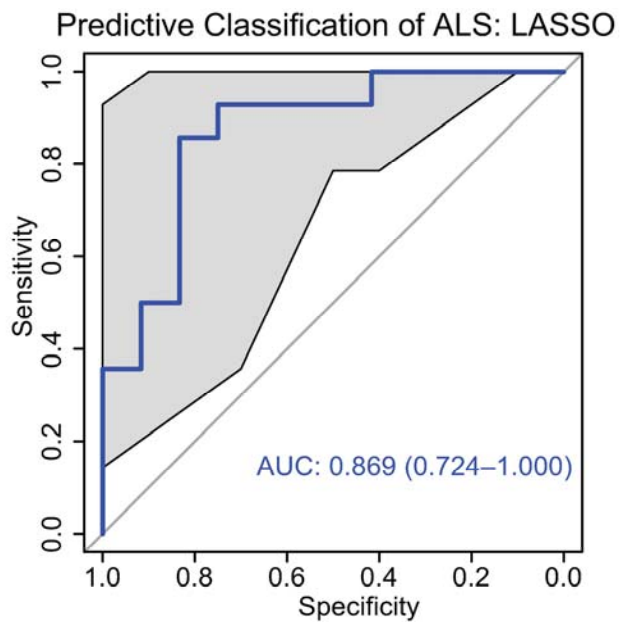


# ALS Results



Claudia Figueroa-Romero et al. 2020. Annals of Clinical and Translational Neurology

## ALS Results



Curtin P, Austin C, Curtin A, Gennings C, Figueroa-Romero C, Mikhail KA, et al. (2020). PLoS Comput Biol 16(4): e1007773.

## 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

## **Acknowledgments**

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