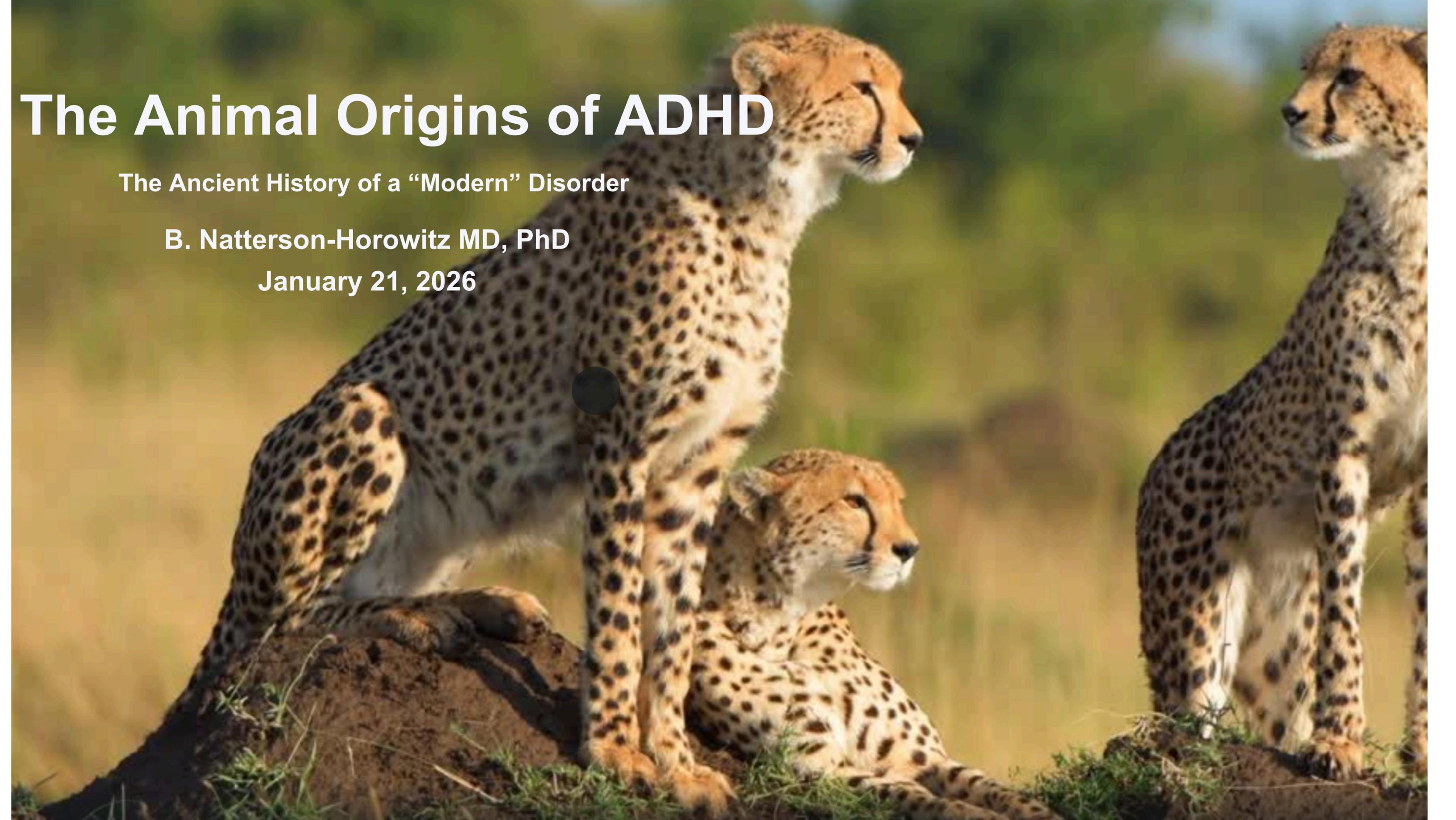


The Animal Origins of ADHD

A photograph of three cheetahs in a savanna setting. One cheetah is standing on a mound of earth on the left, looking towards the right. Another cheetah is lying down in the center, also looking right. A third cheetah is standing on the right side of the frame, looking towards the left. The background is a blurred green and yellow landscape under a bright sky.

The Ancient History of a “Modern” Disorder

B. Natterson-Horowitz MD, PhD

January 21, 2026

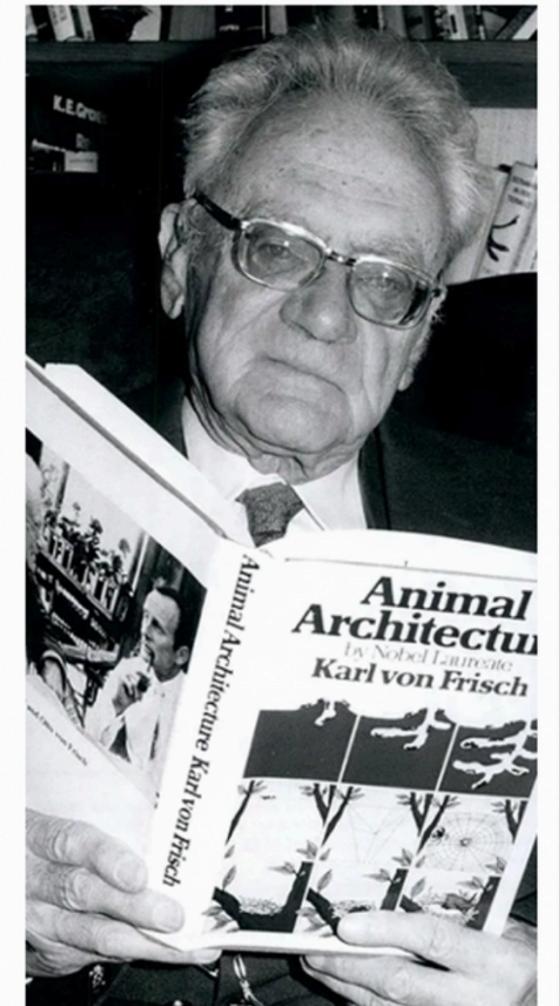
1973 Nobel Prize Medicine & Physiology



Konrad Lorenz



Niko Tinbergen



Karl Von Frisch

Animal Behaviorists

Psychiatry Residency 1987-1991



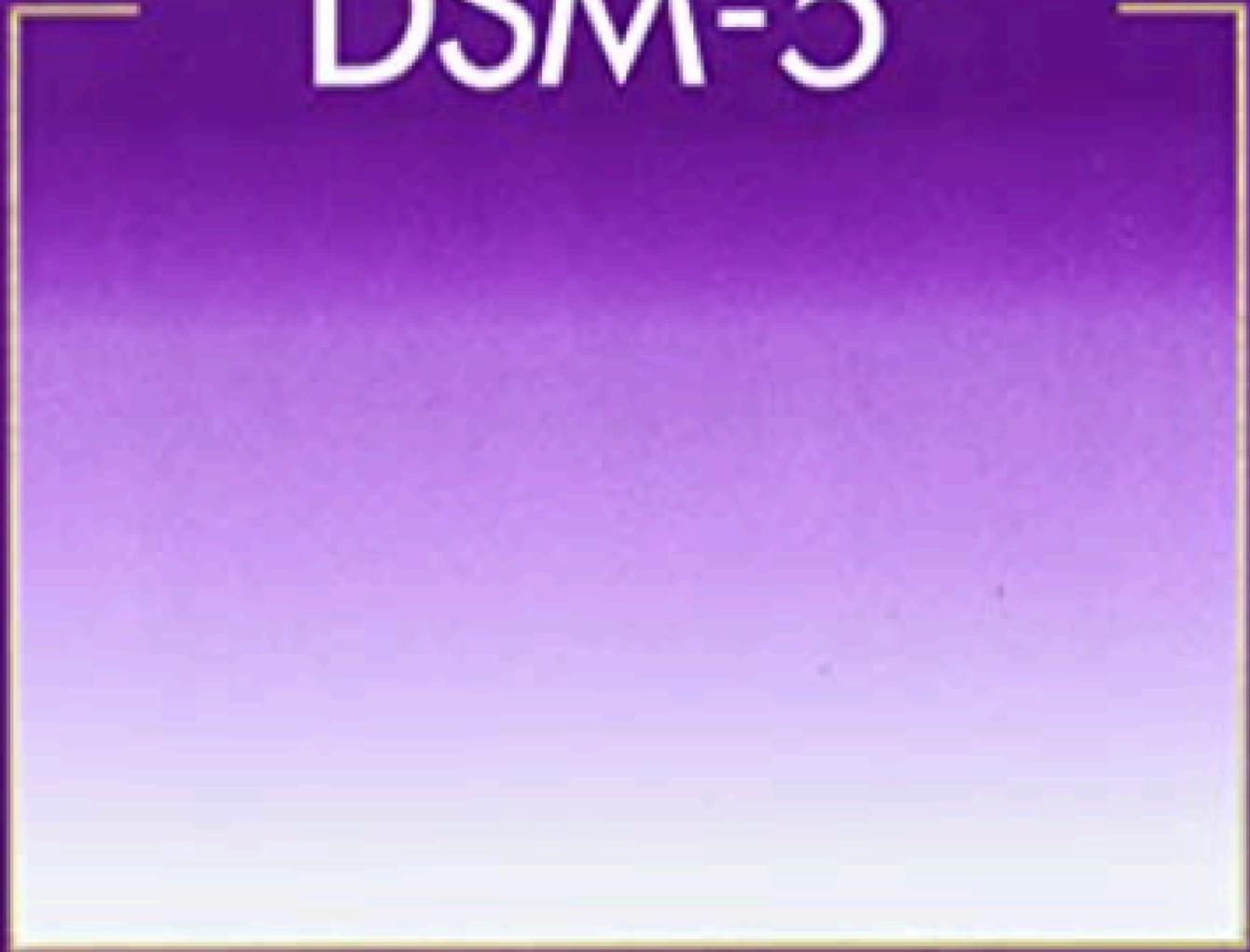
Courtesy of Welton Becket and Associates, and archives of Bruce D. Becket

UCLA Neuropsychiatric Institute

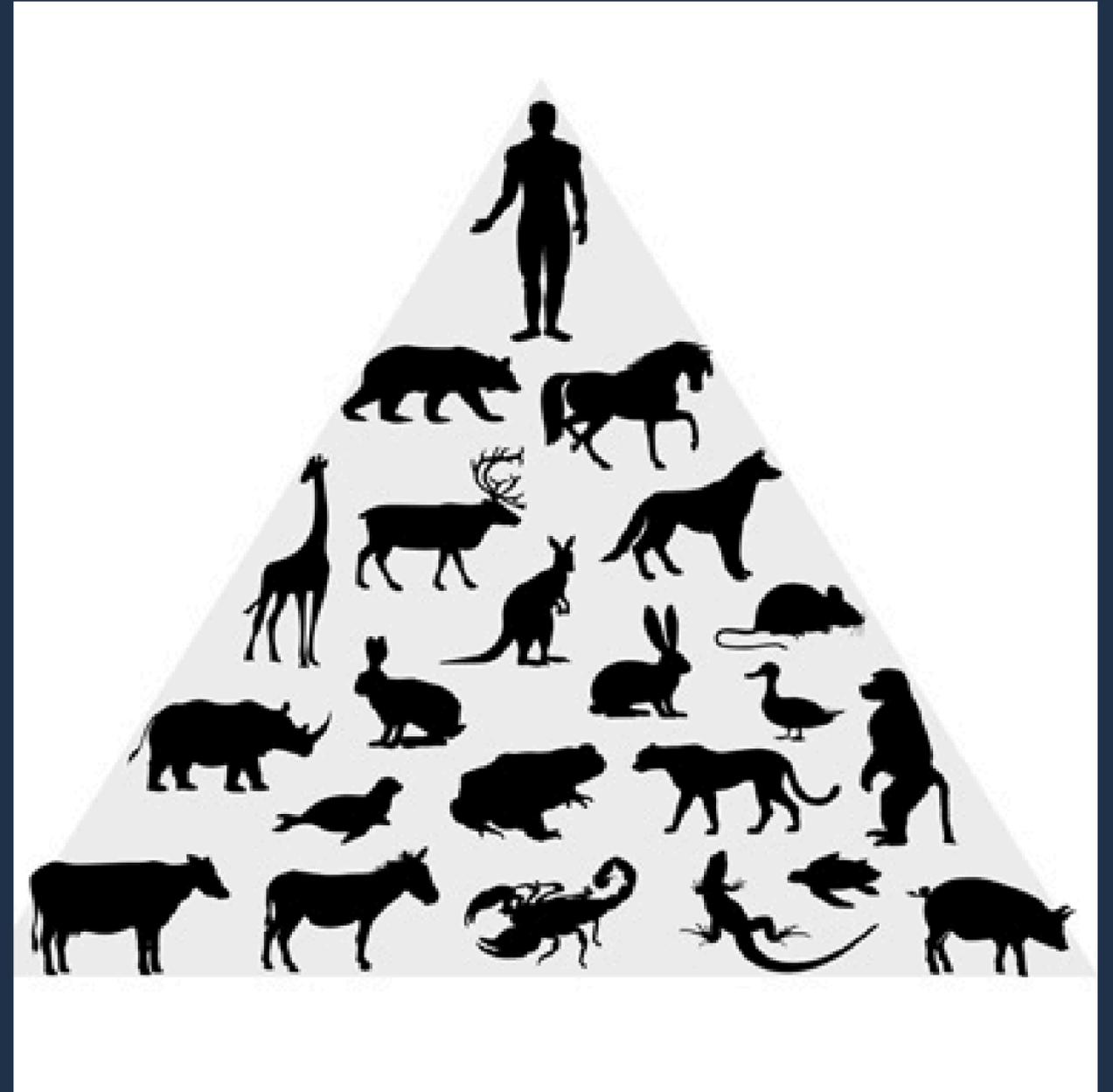
MANUAL OF
MENTAL DISORDERS

FIFTH EDITION

DSM-5[®]



Human Exceptionalism

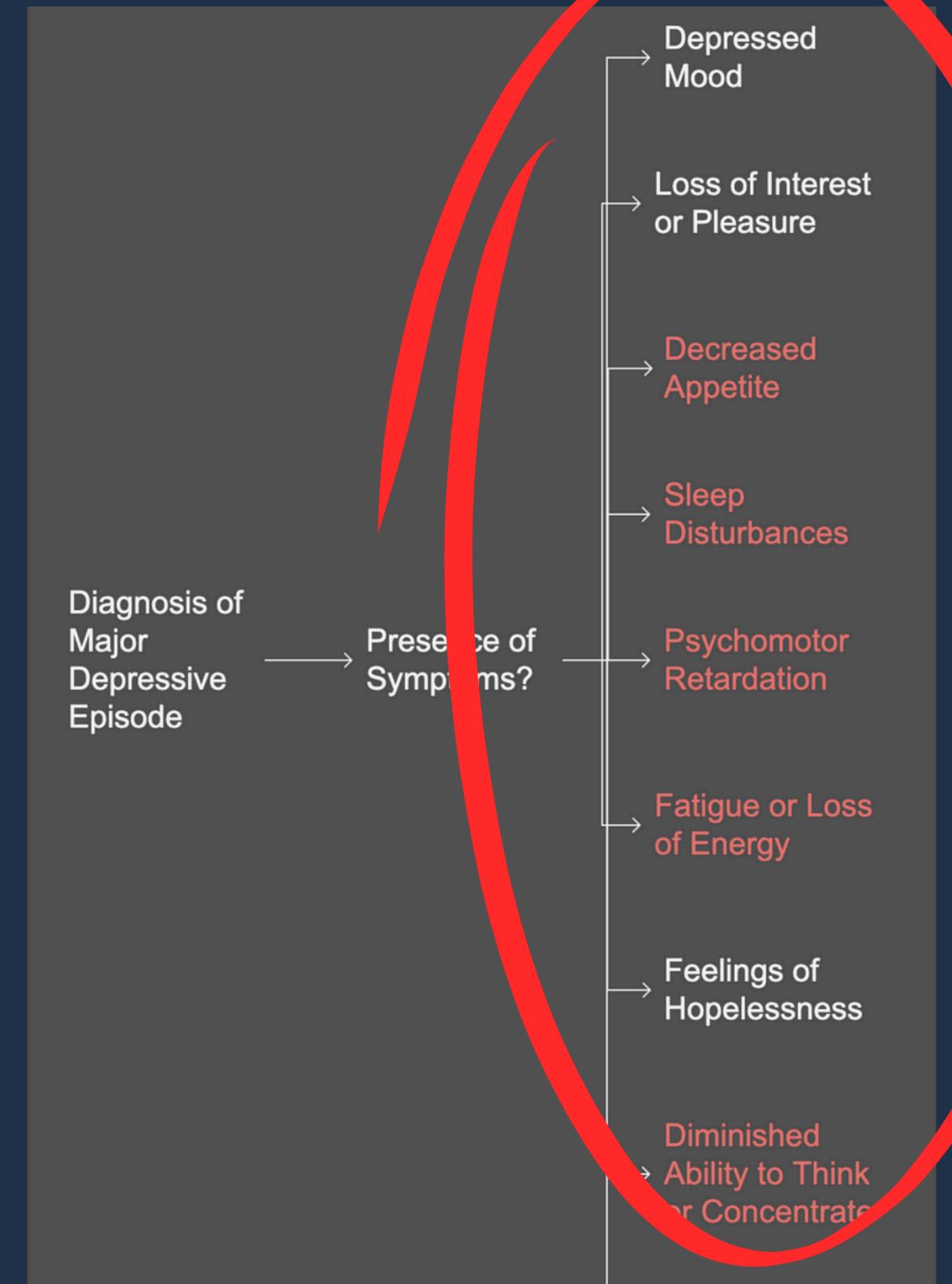


Depression

Neurovegetative Symptoms



Neurovegetative Symptoms



**Fitness Benefits of
Neurovegetative Symptoms of
Depression?**



Neil Greenberg and David Crews (1989) General and Comparative Endocrinology
Neil Greenberg and David Crews (1989) General and Comparative Endocrinology

Jacqueline Rose, et al. (2017) PLOS ONE

Jacqueline Rose, et al. (2017) PLOS ONE

Social Defeat

The Clinical Reality

ADHD is a complex neurodevelopmental disorder affecting 8–12% of children worldwide.

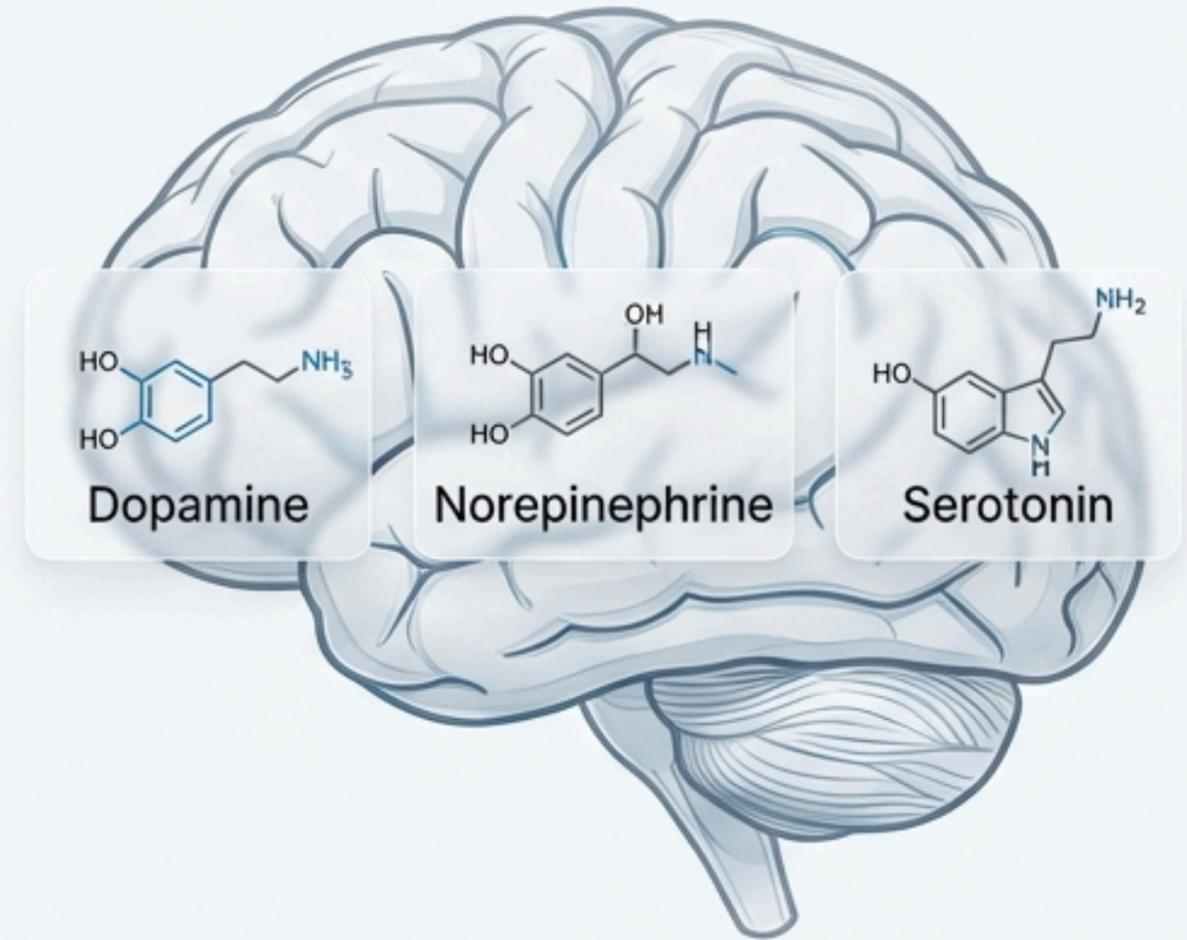
The etiology is multifactorial (Genes + Environment) and symptoms often persist into adulthood.

The Clinical Triad

- Inattention
- Hyperactivity
- Impulsivity

High rates of comorbidity with affective disorders, substance abuse, and conduct disorders.

The Treatment Gap

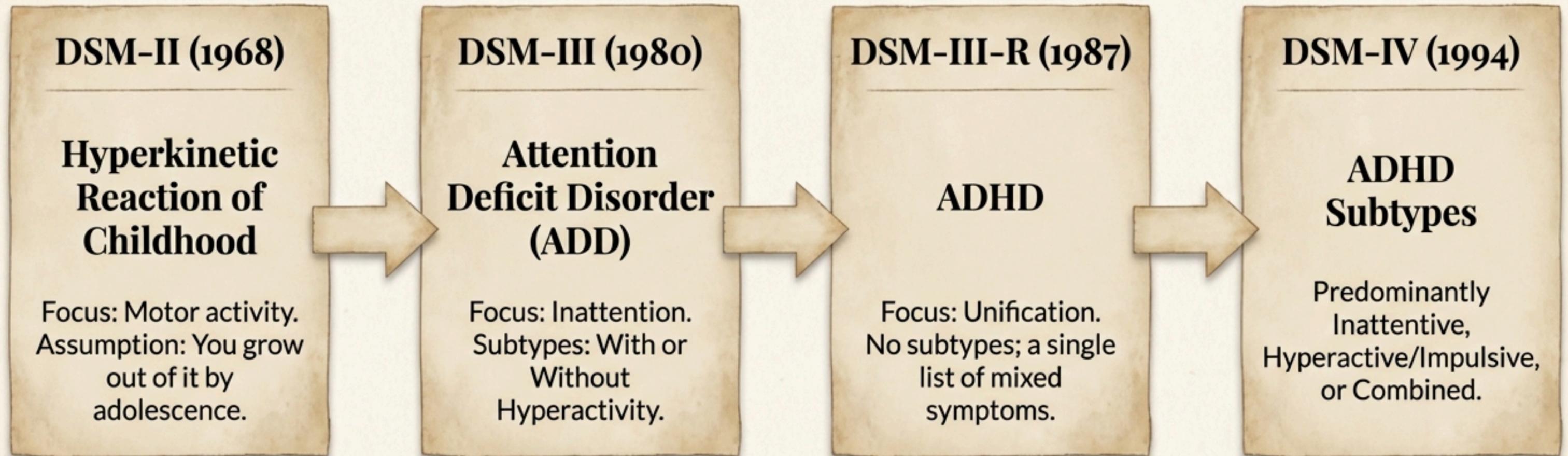


Key Insight: Pathology involves aberrant changes in monoaminergic systems.

The Problem: Current psychostimulants (e.g., Methylphenidate) treat symptoms but not causes, and carry significant side effects.

ADHD
Brief History of a
“Modern” Diagnosis

Refining the Classification (1968–2000)



Key Takeaway: The DSM-IV field trials were the most empirically based in history, finally recognizing that the disorder persists into adulthood.

What is ADHD?



Three Core Features

- Inattention
- Hyperactivity
- Impulsivity

Prevalence: 5-10% of population maintained across cultures

Heritability: 70-80% genetic component

Table 1: DSM 5 criteria for adult ADHD

DSM 5 criteria - Adult ADHD

- Criteria A** Five or more symptoms of inattention or hyperactivity/impulsivity
- Criteria B** Several symptoms present by the age 12
- Criteria C** Several symptoms present in two or more settings
- Criteria D** Several interfere with or reduce quality of social, economical or occupational functioning
- Criteria E** Symptoms are not better explained by another condition, such as mood disorder

DSM 5 ADHD symptoms - Inattention

- **INATTENTION (nine symptoms)**
 - a) Lack of attention to detail, make careless mistakes
 - b) Difficulty sustaining attention
 - c) Does not listen when spoken to directly
 - d) Trouble completing or finishing jobs or tasks
 - e) Problems organizing tasks and activities
 - f) Avoids or dislikes sustained mental effort
 - g) Loses and misplaces things
 - h) Easily distracted
 - i) Forgetful in daily activities

DSM 5 ADHD symptoms - hyperactivity/impulsivity

- **HYPERACTIVITY (six symptoms)**
 - a) Fidgetiness (hands or feet) or squirming in seat
 - b) Leaves seat when not supposed to
 - c) Restless or overactive
 - d) Difficulty engaging in leisure activities quietly
 - d) Always 'on the go'
 - d) Talks excessively
- **INATTENTION (nine symptoms)**
 - g) Blurts out answers before questions have been completed
 - h) Difficulty waiting in line or taking turns
 - i) Interrupts or intrudes on others when they are working or busy

Reframing

Traditional View

Disorder • Deficit • Dysfunction

Something wrong to be fixed

Alternative Lens

Evolved attentional strategy

Adaptive in certain contexts

Evolutionary Lens

Traditional View

Disorder • Deficit • Dysfunction
Something wrong to be fixed

Alternative Lens

Evolved attentional strategy
Appears in certain contexts

The Evolution of Attention

Distractibility as a
feature, not a bug

Scanner vs Focuser Strategies

SCANNER

Rapid attention shifting

Broad environmental monitoring

High novelty responsiveness

Examples:

Prey species • Juveniles

Subordinate animals

FOCUSER

Sustained attention

Deep task engagement

Less environmental scanning

Examples:

Apex predators

Tool-using animals

Adaptive when:

High predation

Unpredictable resources

Novel environments

Adaptive when:

Low threat

Complex problems

Stable environments

Scanner brains aren't broken Focuser brains — they're different solutions to different problems

The Neuroscience: Two Key Systems

Locus Coeruleus System

High tonic: Scanner mode

Low tonic, high phasic: Focuser mode

Prefrontal Cortex Development

Delayed maturation in ADHD

Also seen in young animals across species

Juvenile traits serve developmental functions

DRD4 7-Repeat Allele

Found in ADHD and migratory bird species

The Dopamine Story

How Dopamine Systems Evolved

Dopamine circuits prioritize immediate, novel, rewarding stimuli

This makes evolutionary sense: unpredictable food, immediate threats

Foraging Example

Squirrel finds nut: Dopamine surge → intense focus

When threat high: System shifts to scanning

Implication for ADHD

Video games: Novel, immediate, unpredictable rewards

Homework: Delayed rewards, predictable, low novelty

EVIDENCE SUMMARY: Animal Models of ADHD and Human Neurobiology Translation

Species	ADHD-like Behavior	Neurobiological Evidence	Genetic Evidence	Pharmacological Validation	Strength of Evidence
		<ul style="list-style-type: none"> • ↓ PFC dopamine • ↓ Striatal D1/D2 • Altered NAc signaling 	<ul style="list-style-type: none"> • Multiple QTLs • Altered DAT expression 	<ul style="list-style-type: none"> • Methylphenidate ✓ • Atomoxetine ✓ 	★★★
		<ul style="list-style-type: none"> • Disrupted PFC-striatal circuits • Altered glutamate signaling 	LPHN3/ADGRL3 deletion	<ul style="list-style-type: none"> • Methylphenidate ✓ 	★★★
		<ul style="list-style-type: none"> • ↑↑ Synaptic DA • ↓ DA storage • Altered 5-HT1B 	SLC6A3 (DAT) knockout	<ul style="list-style-type: none"> • Amphetamine paradox ✓ • Guanfacine ✓ 	★★★
		<ul style="list-style-type: none"> • ↓ Serum dopamine • Altered reward processing 	DRD4 variants (7R-like)	Limited studies	★★
		<ul style="list-style-type: none"> • Pallium-striatum circuits • DA/NE systems 	dat, drd4, lphn3 orthologs	<ul style="list-style-type: none"> • Methylphenidate ✓ • Atomoxetine ✓ 	★★

★★★ = Strong translational evidence | ★★ = Moderate translational evidence | ★ = Preliminary evidence | ✓ = Validated response
 DA = Dopamine | NE = Norepinephrine | PFC = Prefrontal Cortex | NAc = Nucleus Accumbens | QTL = Quantitative Trait Loci

Attentional Diversity in Nature

Why Different Strategies Exist

Every animal faces the same challenge: limited attentional resources

Different ecological niches favor different solutions

Examples: Scanners

Hummingbirds: rapid attention switching between flowers

Rabbits: constant environmental monitoring

Juvenile primates: exploratory, novelty-seeking

Examples: Focusers

Owls: sustained focus on prey detection

Crows: deep engagement with tool problems

Adult predators: hunting concentration

Key Insight: Both strategies are equally "real" and equally adaptive

Context — not the brain itself — determines fitness

Canine ADHD-Like Behaviors: A Mirror to Human Neurodevelopment

Insights from a cohort study of 11,000 Finnish dogs on Hyperactivity, Impulsivity, and Inattention.

Based on research by S. Sulkama, J. Puurunen, et al., *Translational Psychiatry* (2021).



Australian Shepherd



Jack Russell Terrier



German Shepherd



Chihuahua



Understanding the 'Bad Dog'.



The hyperactive or inattentive dog is not simply 'disobedient.' They are navigating a complex intersection of genetics, biology, and environmental stress—just like us.

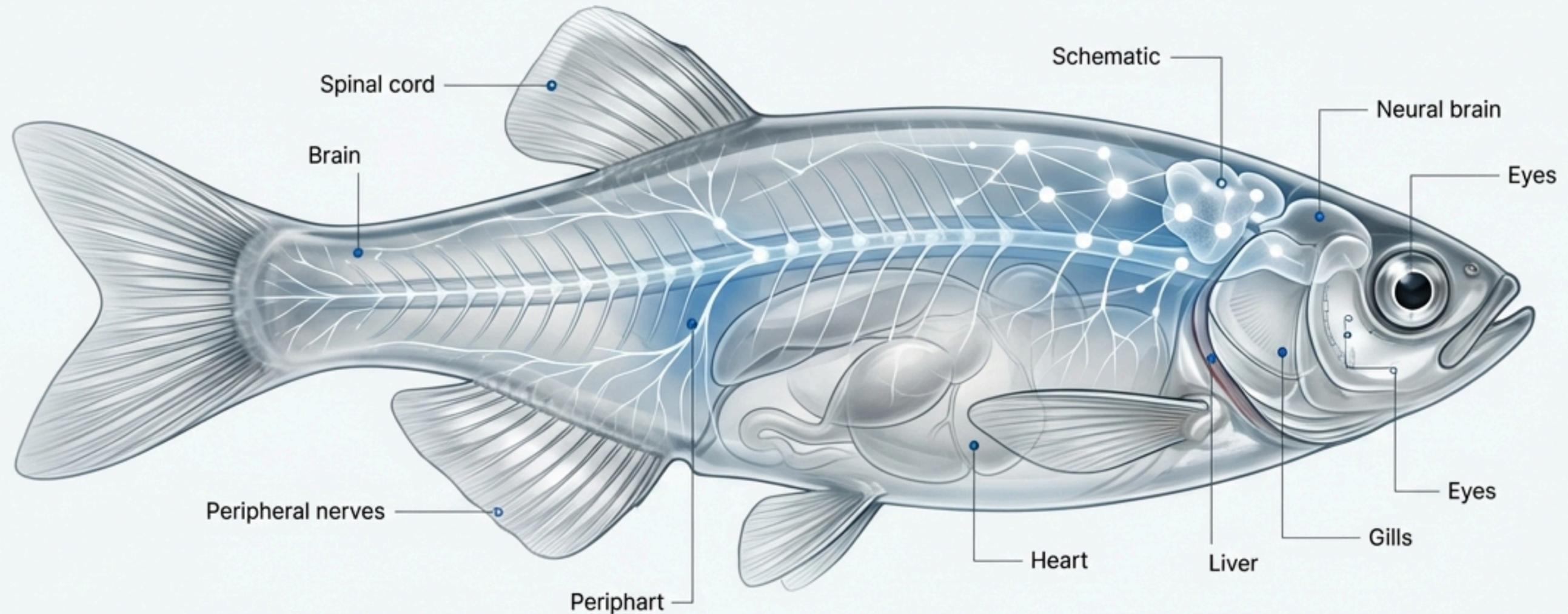
Published online: 01 October 2021



Canine hyperactivity, impulsivity, and inattention share similar demographic risk factors...
Sulkama, S., Puurunen, J., Salonen, M. et al. *Translational Psychiatry* 11, 501 (2021).

Decoding ADHD: The Zebrafish Model

Bridging Genetics, Behavior, and Drug Discovery in Translational Neuroscience



Based on the review by Fontana et al., Neuroscience and Biobehavioral Reviews (2019).