

From Noise to Signal:

A Systems Biology Framework Informed by Longitudinal First-Person Observations

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Author's Note

Jacob Boatman is a non-speaking individual with autism who communicates independently using a standard QWERTY keyboard. Over several years, Jacob has consistently described his internal experience using concepts such as "signal," "noise," "traffic," "flow," and "bottlenecks." These observations were documented longitudinally alongside clinical findings, laboratory data, and ongoing therapeutic interventions.

This paper does not claim to establish biological mechanisms. Rather, it proposes that Jacob's observations generate systems-level hypotheses worthy of scientific investigation. The goal is to encourage dialogue between individuals living with autism and researchers studying complex biological systems.

This paper expands upon concepts introduced in our earlier publication, A Systems-Based Hypothesis of Autism: Availability, Transport, and Cycle Completion. While the earlier paper focused primarily on biological availability and transport as potential contributors to neurodevelopment, the present manuscript broadens that discussion into a systems biology framework. Rather than emphasizing isolated pathways, this paper explores how first-person longitudinal observations may generate systems-level hypotheses regarding biological coordination, network behavior, and information flow. The two papers are intended to be complementary, reflecting the natural evolution of our thinking as new observations and scientific perspectives emerged.

Abstract

Autism research has traditionally focused on identifying isolated genetic mutations, neurotransmitter abnormalities, immune dysfunction, or metabolic deficiencies. These approaches have produced valuable discoveries but have not fully explained the remarkable biological diversity observed among autistic individuals, particularly those with regression.

Systems biology proposes that health and disease emerge from interactions among interconnected biological networks rather than isolated molecular pathways. Within this framework, biological function depends not only upon the presence of individual molecules but upon successful coordination among transport systems, signaling pathways, metabolism, immune regulation, cellular membranes, and energy production.

Over several years, one non-speaking autistic individual repeatedly described his internal experience using systems-level language including "noise," "signal," "traffic," "flow," and "bottlenecks." These descriptions were recorded before any formal systems biology framework was developed.

This paper proposes that first-person longitudinal observations may generate scientifically testable systems-level hypotheses regarding neurodevelopment. Rather than presenting definitive mechanisms, the authors propose a conceptual framework integrating biological coordination, nutrient availability, lipid transport, membrane function, neurotransmission, and mitochondrial metabolism as interacting components of a complex adaptive system.

Introduction

Modern biology has produced extraordinary knowledge regarding genes, proteins, enzymes, receptors, and signaling pathways. Yet living organisms do not function as isolated collections of molecular parts. Biological behavior emerges through coordinated communication among thousands of interacting systems.

Systems biology seeks to understand these interactions by studying entire biological networks rather than isolated pathways.

Within this framework, health represents successful coordination across biological systems, while disease may reflect disruption of that coordination.

This perspective does not replace reductionist biology. Rather, it builds upon it by asking how independently functioning biological components cooperate to produce integrated physiological behavior.

The Missing Perspective

Modern autism research has generated enormous amounts of genetic, metabolic, immunologic, and neurological data.

However, relatively little attention has been given to systematic longitudinal descriptions from individuals capable of communicating their internal neurological experience.

This paper proposes that these observations may represent an underutilized source of biological hypothesis generation.

Rather than asking autistic individuals only what they cannot do, systems biology may also ask:

How do they experience biological function?

Longitudinal Observations

Over multiple years Jacob repeatedly described concepts including:

- Noise
- Signal
- Internal traffic
- Flow
- Bottlenecks
- Cycle completion
- Biological availability
- Transport

These concepts were expressed independently over numerous conversations before being organized into the present framework.

Importantly, these observations describe system behavior rather than isolated molecules.

A Systems Biology Interpretation

From a systems perspective, these observations may represent descriptions of network behavior.

Traffic may represent impaired biological coordination.

Flow may represent successful movement of biological information.

Bottlenecks may describe rate-limiting processes within interconnected pathways.

Signal may represent coordinated neural communication.

Noise may reflect disruption of organized biological information.

Whether these interpretations prove biologically accurate remains unknown.

However, they generate hypotheses that can be experimentally examined.

Biological Coordination

The present hypothesis proposes that biological performance depends upon successful coordination among multiple interacting systems including:

- Nutrient transport
- Lipid metabolism
- Cell membrane dynamics
- Mitochondrial energy production
- Neurotransmitter regulation
- Immune signaling
- Redox biology
- Gene regulation

Rather than viewing these systems independently, this framework proposes they function as an integrated biological network.

Mechanistic Hypotheses

Within this systems framework, Jacob proposed several specific hypotheses requiring experimental evaluation.

These include potential relationships involving:

- Lipid transport
- Lysosomal acid lipase (LAL)
- LDL-mediated transport
- Vitamin B12 utilization
- Membrane biology
- Serotonin regulation
- Cellular signaling

These observations should be regarded as hypotheses generated through longitudinal communication rather than established biological mechanisms.

Testable Predictions

A systems biology framework permits specific experimental questions.

Examples include:

- Do changes in biological coordination correlate with changes in subjective cognitive experience?
- Can longitudinal first-person observations predict measurable physiological changes?
- Do lipid transport, membrane composition, and nutrient utilization interact more extensively than currently appreciated?
- Can systems-level computational models identify biological bottlenecks associated with regression autism?

Importantly, each question can be experimentally investigated without assuming the hypothesis is correct.

Future Directions

Future research should integrate:

- Longitudinal clinical observations
- Multi-omics technologies
- Artificial intelligence
- Systems biology modeling
- First-person experiential reports

The convergence of these data sources may provide insights unavailable through any single approach alone.

Conclusion

This paper does not argue that autism results from a single pathway, gene, nutrient deficiency, or molecular abnormality.

Instead, it proposes that a subset of autism may be better understood as altered coordination among interconnected biological systems.

Whether this framework ultimately proves correct will depend entirely upon experimental investigation.

Nevertheless, the observations presented here suggest that individuals living with autism may contribute unique systems-level insights capable of generating novel scientific hypotheses.

If systems biology seeks to understand how biological networks communicate, adapt, and coordinate, then carefully documented first-person observations may represent an important and largely unexplored source of information.