Strategic Identification of Principal Investigators for Advanced Computational Modeling in Cognition and Neurodynamics

I. Executive Synthesis: Actionable Intelligence Summary

The current landscape of theoretical and clinical neuroscience demands a shift away from static, linear models of brain function toward sophisticated methodologies derived from complex systems science, including dynamical systems, stochastic modeling, and non-classical probability frameworks. This necessity is driven by the empirical failure of traditional models to explain subjective experience, human decision anomalies, and time-varying neural pathology.

This analysis identifies and profiles Principal Investigators (PIs) whose existing research programs are optimally positioned to collaborate with computational experts specializing in complex systems modeling. Collaboration with these PIs offers immediate opportunities to contribute to foundational theory, empirical testing, and translational clinical biomarker development, enhancing the competitiveness of future grant applications.

Strategic Overview of Collaborative Thrusts: The Non-Linear Imperative

Breakthroughs in cognitive research hinge upon embracing the complexity inherent in biological systems. Evidence across disparate domains demonstrates that phenomena like consciousness, rapid decision-making, and neurodevelopmental disorders are fundamentally governed by non-linear dynamics, where temporal variation and causal integration are paramount.

The research materials confirm three synergistic thrusts that collectively validate the urgency of adopting a computational systems approach:

1. **Thrust A: Theoretical Foundations (Integrated Information Theory, IIT):** IIT posits that consciousness is identical to integrated information, mathematically quantified by Φ.[1] This framework explicitly rules out functionalist or eliminativist theories, demanding a physical system with reentrant architecture and intrinsic cause-effect power.[1] The core computational challenge is calculating Φ for large, realistic neural systems, which necessitates advanced computational methods to manage exponential complexity.[2]
2. **Thrust B: Cognitive Dynamics (Quantum Cognition):** Cognitive scientists encounter "paradoxical findings" where human decision-making violates the laws of classical probability theory.[3] This failure stems from incompatible measurements—where the act of measuring one variable disturbs a second measurement—mirroring problems faced by physicists who abandoned classical dynamics.[4] Quantum probability models, which incorporate concepts like superposition [5], provide the necessary mathematical structures to accommodate these effects and offer predictive models for complex scenarios like the Prisoner's Dilemma.[3]
3. **Thrust C: Translational Application (Complex Dynamical Network Modeling):** In clinical neuroscience, static or time-averaged functional connectivity analysis proves insufficient for detecting critical neural biomarkers.[6] Studies on Autism Spectrum Disorder (ASD) have shown that the expression of restricted and repetitive behaviors (RRBs) is associated with aberrant *time-varying* cross-network interactions in cognitive control and motor circuits. Specifically, the dynamic analysis, unlike time-averaged methods, successfully identified reduced inflexibility in cognitive control circuits predicting specific symptoms (Circumscribed Interests/Insistence of Sameness).[6] This finding mandates the application of sophisticated dynamical systems theory for clinical translation.

The unifying theme across these thrusts is the systematic empirical inadequacy of classical modeling approaches. Whether measuring consciousness, choice behavior, or brain disorders, a methodology focused on quantifying dynamic processes and causal architecture is required.

Top-Tier Recommendation Matrix (Table 1: Actionable Contact Summary)

The following table summarizes the highest-priority PIs for initiating collaboration on advanced computational modeling projects. These researchers represent the vanguard in developing, testing, or applying non-classical cognitive theories.

Table 1: Actionable Contact Summary and Strategic Fit

PI Name	**Institution**	**Primary Research Thrust**	**Strategic Synergy Point**	**Email Address (Verified/Derived)**
Giulio Tononi, M.D., Ph.D.	UW–Madison	IIT & Consciousness (Theoretical)	Foundational theory development; access to Φ modeling architecture.	tononi@psychiatry.wisc.edu
Christof Koch, Ph.D.	Allen Institute	IIT & Consciousness (Empirical)	Driving empirical testing and adversarial collaborations (COGITATE); leveraging large-scale data (OpenScope).	kochc@alleninstitute.org
Jerome R. Busemeyer, Ph.D.	Indiana University	Quantum Cognition (Modeling)	Authority in mathematical and dynamic non-classical modeling of human judgment and decision-making.	jbusemey@iu.edu

Jonathan Touboul, Ph.D.	Brandeis University	Complex Systems (Mathematical)	Expertise in analytical dynamical systems and stochastic models of neural activity, plasticity, and development.	j.touboul@brandeis.edu
Vinod Menon, Ph.D. / Kaustubh Supekar, Ph.D.	Stanford University	Network Dynamics (Translational)	Pioneers in applying time-varying network dynamics to identify dissociable, clinical biomarkers in neurodevelopmental conditions (ASD).	menon@stanford.edu / ksupekar@stanford.edu
Damian Milton, Ph.D.	University of Kent	Monotropism (Psychological Theory)	Provides foundational psychological theory (Monotropism) compatible with complex dynamic modeling of highly stable attentional states.	D.Milton@kent.ac.uk

II. Definitional Frameworks: The Intellectual

Landscape for Computational Support

2.1 Thrust A: Integrated Information Theory (IIT) and the Physics of Consciousness

Integrated Information Theory, initially proposed by Dr. Giulio Tononi in 2004 [1], defines consciousness not by function, but by the intrinsic cause-effect power of a physical system upon itself.[1] Consciousness is claimed to be identical to the specific quantity of integrated information, measured by the metric Φ (Phi).[1]

This approach inherently requires expertise in complex systems modeling because the calculation of Φ involves identifying the grouping of elements within a system that possesses maximum causal power—the "main complex".[1] The theory explicitly states that consciousness requires a physical realization involving reentrant architecture and feedback loops, ruling out purely functionalist accounts.[1] Therefore, advanced computational methods are mandatory for operationalizing and testing IIT, especially when scaling up to systems as complex as the human brain.[2]

Strategic Alignment with IIT Pioneers

Dr. Giulio Tononi (UW-Madison) is the principal theoretical architect of IIT, leading the Center for Sleep and Consciousness.[2] Collaboration with Dr. Tononi and his core team (including Albantakis, Boly, and others listed in the overview [2]) provides direct access to the latest theoretical developments and algorithmic architectures for Φ computation. The primary value proposition for a computational expert is addressing the massive complexity involved in calculating integrated information across large neural systems, proposing efficient algorithms, or network compression techniques that preserve causal structure while reducing computational load. Based on the institutional affiliation with the Department of Psychiatry and Behavioral Sciences at the University of Wisconsin-Madison [7], the most likely institutional email format leads to the contact address: tononi@psychiatry.wisc.edu.

Dr. Christof Koch (Allen Institute) serves as the critical bridge for empirical validation. Dr. Koch is a leading expert involved in insightful discussions about neuroscience, artificial intelligence, and reality.[8] Critically, Dr. Koch is associated with the COGITATE project, an adversarial collaboration explicitly focused on arbitrating between competing theories of consciousness.[8] This signifies a robust, institutionally supported commitment to rigorous, large-scale empirical testing of IIT.

Working with Dr. Koch aligns research with the vast resources of the Allen Institute, which supports platforms like OpenScope for high-throughput and reproducible neurophysiology.[8] This platform provides essential standardized data sets that are necessary for model comparison and falsification, a non-negotiable requirement for competitive NIH funding today.[9] The synergy here is clear: pure theoretical work requires empirical validation, and the Allen Institute provides the data infrastructure. The high-level institutional role suggests a standard institutional email structure: kochc@alleninstitute.org.

2.2 Thrust B: Quantum Cognition and Non-Classical Decision Theory

Cognitive science has increasingly turned to quantum probability theory to accommodate experimental findings that violate classical laws of probability.[3] These "paradoxical findings" are often observed in complex decision-making scenarios, such as the Prisoner's Dilemma game or the Two Stage Gambling game.[3] These phenomena arise because measurements in cognitive systems are frequently incompatible, meaning the initial observation perturbs the system's state, preventing full simultaneous information capture—a parallel noted by early quantum physicists.[4]

The application of quantum theory to psychological and cognitive sciences allows researchers to replace classical probabilities with quantum probability amplitudes, using frameworks such as the quantum-like Bayesian Network formalism.[3] This methodology offers a general statistical model capable of making accurate predictions where traditional models fail.[3]

Strategic Alignment with Quantum Cognition Leaders

Dr. Jerome R. Busemeyer (Indiana University) is the preeminent authority in dynamic and quantum models of judgment and decision-making.[11] His work is focused on rigorous mathematical models, including research into applications for complex decisions, such as medical judgments.[11] Collaboration with Dr. Busemeyer offers the chance to engage directly with the methodological forefront of non-classical modeling.

A crucial computational challenge identified within this field is the "exponential growth of quantum parameters that need to be fit".[3] This computational bottleneck prevents quantum cognitive models from easily scaling to more complex decision scenarios. Expertise in advanced network theory, optimization heuristics, or large-scale data analysis is essential to developing methods, such as similarity heuristics, that automatically manage this exponential parameter space.[3] This defines a specialized and high-value contribution for a computational neuroscientist. Dr. Busemeyer's institutional page explicitly confirms his email address: jbusemey@iu.edu.[11]

2.3 Thrust C: Complex Dynamical Systems and Translational Neuroscience

The brain is a complex dynamical system, capable of learning non-linear and even chaotic dynamics necessary for tasks like motor control.[13] Modeling these processes requires techniques like the Lyapunov method to ensure stability of the learning process.[13] Furthermore, the analysis of neurological disorders necessitates moving beyond static representations of brain networks toward quantifying their temporal evolution and dynamical flexibility.

Strategic Alignment in Dynamics and Clinical Translation

Dr. Jonathan Touboul (Brandeis University) serves as the ideal foundational mathematical partner. As Professor and Chair of Mathematics at Brandeis, his research focuses on dynamical and stochastic models arising in biology and neuroscience.[14] His work addresses how stochastic neural activity yields regular dynamics and models plasticity mechanisms (learning).[14] Dr. Touboul collaborates enthusiastically with experimentalists to develop and study mathematical models of brain activity, from single-cell up to large neuronal areas.[15] His analytical expertise is critical for rigorously deriving properties (e.g., stability, bifurcation points) of the complex network models developed for cognitive disorders. Utilizing the standard faculty naming convention at Brandeis, the derived email address is: j.touboul@brandeis.edu.

Drs. Kaustubh Supekar and Vinod Menon (Stanford University) represent the critical translational application point. Their research on Autism Spectrum Disorders (ASD) provides compelling empirical justification for dynamic analysis.[6] They demonstrated that Restricted and Repetitive Behaviors (RRBs) are associated with distinct, dissociable patterns of dynamics in brain circuits: reduced and inflexible time-varying cross-network interactions in cognitive control circuits predicted symptoms like insistence of sameness (IS) and circumscribed interests (CI).[6] Importantly, this relationship was *not detected* using traditional time-averaged functional connectivity analysis.[6] This finding elevates dynamic modeling from a theoretical preference to a necessary component of clinical biomarker discovery. The confirmed contact information is available directly from their publication: ksupekar@stanford.edu and menon@stanford.edu.[6]

Dr. Damian Milton (University of Kent) offers the necessary theoretical foundation from the psychological perspective of neurodiversity. Dr. Milton is a sociologist and social psychologist known for advancing the concept of the "double empathy problem" and advocating for theories of autism such as Monotropism.[17] Monotropism posits that autism centers on the tendency to concentrate attention deeply on a limited number of interests.[19] This state of intense concentration often leads to "flow" or optimal experience.[19]

From a computational neurodynamics perspective, Monotropism can be mathematically interpreted as a highly stable, deep attractor state within the neural system's phase space. The challenges associated with shifting attention or adapting to new tasks can then be modeled as the high energetic or computational cost required to force a transition out of this highly robust attractor. This approach provides a mechanism to connect complex psychological phenomena (Monotropism) directly to quantifiable dynamic metrics (stability, transition time), aligning Milton's work with the non-linear network analysis required by Supekar and Menon.[6] Utilizing the standard UK institutional email format, the derived address is: D.Milton@kent.ac.uk.

III. Strategic PI Profiles: Defining Research Compatibility and Outreach Strategy

3.1 PIs in Integrated Information Theory & Consciousness

PI Name	Research Compatibility	Outreach Strategy Focus
Dr. Giulio Tononi	High. Need for efficient algorithms to calculate	Propose novel computational techniques (e.g., matrix factorization,

	Φ at scale.	graph simplification) that preserve causal structure for large system Φ estimation.
Dr. Christof Koch	High. Access to empirical data platforms (OpenScope) and COGITATE testing protocols.	Propose the development of reproducible, high-throughput computational workflows to test IIT predictions using Allen Institute data, focusing on model comparison.

The core challenge for IIT is scalability. The initial work by Tononi and collaborators (Albantakis, Boly, et al. [2]) laid the theoretical groundwork, but practical application to complex biological systems remains computationally prohibitive. A strong outreach strategy for Dr. Tononi must address this bottleneck directly, demonstrating that the computational expertise can operationalize IIT by moving beyond theoretical proofs toward practical, system-level measurements.

For Dr. Koch, the strategic value lies in the institutional weight of the Allen Institute.[20] Collaboration here provides leverage for large-scale grant proposals that require rigorous data standards and infrastructure. The proposal must specifically reference existing, ambitious projects like COGITATE [8], offering to provide the dynamic modeling expertise necessary to analyze the complex neurophysiological data collected through platforms like OpenScope.[8]

3.2 PI in Quantum Cognition and Decision Dynamics

PI Name	**Research Compatibility**	**Outreach Strategy Focus**
Dr. Jerome R. Busemeyer	Extremely High. Direct methodological need for parameter control in	Offer computational expertise to solve the "exponential growth of quantum parameters"

	scalable quantum models.	problem [3] through the development of structured network architectures or optimized fitting heuristics. Emphasize applications to high-stakes decision contexts (e.g., medical judgment [11]).

Dr. Busemeyer's research has progressed from defining the necessity of quantum cognitive models to developing predictive frameworks.[11] The major barrier to broader adoption and generalization of these models is methodological complexity. The proposal should leverage expertise in complex Bayesian networks and advanced optimization algorithms to provide a tractable solution for parameter fitting, allowing the models to scale robustly beyond simple games to real-world behavioral datasets.[3] This addresses a clear, published methodological limitation in his field, making the offer of support highly targeted and valuable.

3.3 PIs in Complex Systems, Neurodiversity, and Dynamics

PI Name	**Research Compatibility**	**Outreach Strategy Focus**
Dr. Jonathan Touboul	High. Analytical rigor required for validating computational models of plasticity and dynamics.	Propose a joint effort to derive analytical properties (e.g., stability and noise effects) for the stochastic dynamic models relevant to clinical (ASD) or theoretical (IIT) frameworks. Focus on mathematically proving the robustness of proposed dynamic biomarkers.
Drs. Supekar & Menon	Highest. Their findings validate dynamic methodology in clinical settings.	Offer to advance their time-varying analysis [6] by applying true non-linear quantification, such as chaotic system metrics

		(e.g., Lyapunov exponents, fractal dimension) to characterize the *quality* of the aberrant network dynamics in ASD subtypes.
Dr. Damian Milton	Unique, High-Impact Theoretical Match (Monotropism).	Propose to computationally model Monotropism as a deep network attractor state, using dynamical systems theory (Touboul's area) to quantify the stability, transition time, and metabolic cost associated with attention shifting, thereby grounding the psychological theory in neurodynamics.

The work by Supekar and Menon at Stanford is foundational because it provides empirical proof of the failure of classical time-averaged metrics in clinical diagnosis.[6] Their findings establish that the temporal dynamics—how the system moves and settles—are the information carriers for specific clinical features. Therefore, the computational support must focus on quantifying these dynamics using metrics beyond mere correlation or simple variance. The proposal should move toward defining the mathematical structure of the dynamic trajectories themselves, which provides a clearer path for developing objective, quantitative biomarkers for specific RRB subtypes (CI/IS vs. RM).[6]

Dr. Touboul's role is complementary, providing the mathematical bedrock for generalizing and validating the dynamic models used in clinical and theoretical work. His expertise in noise-induced phenomena and network plasticity [14] is essential for robust model construction.

The engagement with Dr. Milton is strategically important for integrating theoretical neuroscience with neurodiversity research. The Monotropism theory, often overlooked by mainstream psychologists [19], offers a unified framework for autistic psychology. By modeling this intense concentration as a highly integrated state (linking to IIT's concepts of integration) and a deep dynamical attractor (linking to Touboul's methods), a high-impact, novel research program can be established that translates psychological theory into testable dynamic network hypotheses.

IV. Comprehensive Directory and Outreach Implementation

The following directory provides the compiled list of PIs identified across the three strategic thrusts, including secondary targets whose expertise in network neuroscience, developmental systems, or specific clinical translation makes them highly relevant collaborators.

4.1 Comprehensive Directory of Key Researchers

Table 2: Comprehensive PI Directory for Computational Cognition Research

PI Name	Institution	Expertise Cluster	Email Address (Confirmed/Derived)	Source/Notes
Jerome R. Busemeyer, Ph.D.	Indiana University	Quantum Cognition, Decision Models	jbusemey@iu.edu	Verified, institutional page [11]
Kaustubh Supekar, Ph.D.	Stanford University	Network Dynamics, ASD	ksupekar@stanford.edu	Verified, Nature Communications article [6]
Vinod Menon, Ph.D.	Stanford University	Network Dynamics, ASD	menon@stanford.edu	Verified, Nature Communications article [6]
Giulio Tononi, M.D., Ph.D.	UW–Madison	Integrated Information Theory (IIT)	tononi@psychiatry.wisc.edu	Derived, standard UW-Madison Psychiatry format [2]

Christof Koch, Ph.D.	Allen Institute for Brain Science	Empirical Consciousness, IIT	kochc@alleninstitute.org	Derived, standard research institute format [20]
Jonathan Touboul, Ph.D.	Brandeis University	Mathematical Neuroscience, Dynamics	j.touboul@brandeis.edu	Derived, standard Brandeis faculty format [14]
Damian Milton, Ph.D.	University of Kent	Monotropism, Autistic Psychology	D.Milton@kent.ac.uk	Derived, standard UK institutional format [17]
Chiara Cirelli, M.D., Ph.D.	UW–Madison	Sleep/Consciousness Research	cirelli@psychiatry.wisc.edu	Derived, UW-Madison faculty list (Vice Chair for Research) [7]
Lawrence Fung, M.D., Ph.D.	Stanford University	Neurodiversity Project (Translational)	lawrence.fung@stanford.edu	Derived, standard Stanford faculty format [21]
Christoffer Alexandersen, Ph.D.	UPenn	Mathematical Neuroscientist, Dynamical Systems	(To be derived via UPenn directory)	Secondary target for dynamical systems [22]
Kate Brynildsen, Ph.D.	UPenn	Network Neuroscience, Neural Plasticity	(To be derived via UPenn directory)	Secondary target for network neuroscience [22]

4.2 Protocol for Strategic Engagement: Cold Emailing Guidelines

Effective engagement with high-demand PIs requires a demonstration of sophisticated technical understanding and a clear proposal for mutual benefit.[23] The outreach communication must be tailored based on the PI's specific research thrust, moving beyond general statements of interest to address their critical computational bottlenecks.

1. **Lead with Technical Specificity:** In communications with Tononi, Busemeyer, or Touboul, the opening paragraph must immediately reference a specific computational challenge within their work (e.g., parameter explosion in Quantum Bayesian Networks [3] or scaling Φ calculation). For translational PIs like Supekar and Menon, the proposal should immediately reference their findings on time-varying dynamics in ASD [6] and suggest an advanced analytical method (e.g., non-linear metrics) to enhance biomarker specificity.
2. **Acknowledge Data and Ethics:** When targeting PIs involved in human subjects research (e.g., Stanford group [6] or the Neurodiversity Project [21]), mentioning familiarity with Institutional Review Board (IRB) protocols, CITI training, and the management of study records demonstrates professionalism and readiness to integrate into established clinical protocols.[24]
3. **Propose Low-Commitment Next Steps:** A high-volume PI may not immediately dedicate significant time to a new collaboration. Suggesting a brief, focused virtual meeting or phone call (e.g., 15 minutes) to discuss the specific proposal allows the PI to assess intellectual compatibility quickly, lowering the barrier to entry compared to demanding an immediate full commitment to a project.[24] If a response is not received, cold emailing is a recognized norm in academic research, and follow-up attempts should be planned.[24]

V. Strategic Expansion of Research Themes and Future Directions

The identification of these PI clusters enables the development of powerful, interdisciplinary grant narratives that address fundamental cognitive science questions through a unified computational lens.

5.1 Integrating IIT and Monotropism via Dynamic Attractors

The neurobiological signature identified by Supekar and Menon—reduced and inflexible time-varying cross-network dynamics in cognitive control circuits in ASD [6]—provides the computational counterpart to the psychological theory of Monotropism advanced by Dr. Milton.[19]

Monotropism describes the highly focused attention characteristic of autism, where specific interests create an intense "flow state" that is psychically beneficial.[19] This focused state can be viewed as a highly stable, complex dynamic configuration within the brain network. A sophisticated computational model would hypothesize that this state is characterized by:

1. **Maximized Local Integration (Φ):** The specific sub-network supporting the Monotropic interest possesses an extremely high value of integrated information (Φ), robustly maximizing its causal power upon itself.[1] This links Milton's theory directly to Tononi's theoretical framework.
2. **Dynamical Rigidity:** The "inflexible" cross-network interactions identified in ASD by Supekar and Menon [6] represent the large energy barrier required to transition the network *out* of this deep attractor state (Monotropic focus) and into a new, separate state. The high stability of the Monotropic attractor explains the observed difficulty in shifting attention or coping with changes associated with ASD.

This synthesized framework provides a unified computational theory of autistic cognition, explaining both the cognitive strengths (flow, deep focus) and the functional difficulties (inflexibility, processing speed weakness [25]) using shared language from dynamical systems theory (Touboul) and integrated information theory (Tononi, Koch).

5.2 Advancing Dynamic Modeling: Beyond Connectivity

While the finding that time-varying connectivity analysis is superior to time-averaged analysis in clinical settings is revolutionary [6], the next step in computational neuroscience must be to move beyond simple time-varying *correlation* toward quantifying the underlying non-linear *structure* of the dynamics.

Future research programs supported by these PIs should involve advanced computational tasks, including:

- **Phase Space Reconstruction and Recurrence Quantification Analysis (RQA):** These methods can be used to characterize the dimensions and complexity of the underlying dynamical attractor governing the cognitive control network. RQA would quantify how frequently the system returns to specific states, providing a quantitative metric for the

"restricted and repetitive behaviors" (RRBs) seen in ASD.[6]
- **Non-linear Time Series Analysis and Chaos Quantification:** Metrics such as Lyapunov exponents should be applied to neural time series data. The Lyapunov exponent measures the sensitivity of a system to initial conditions. Quantifying this metric could provide a precise numerical value for the "inflexibility" observed by Supekar and Menon [6], moving beyond qualitative descriptions to define the chaotic or stable nature of pathological dynamics. Such techniques are highly relevant to mathematical neuroscience research focused on dynamics and chaos theory.[16]

5.3 Quantum Cognition and the Neurodiversity Profile

The application of quantum cognition models (Busemeyer) offers unique pathways to analyze the specific "spiky" cognitive profile observed in neurodivergent populations.[25] Autistic individuals exhibit relative strengths in verbal and nonverbal reasoning but relative weaknesses in processing speed and working memory.[25]

The computational analysis must test the hypothesis that decision-making in these individuals exhibits unique, context-dependent probability violations. Given the highly localized and intense focus inherent in Monotropism, specific inputs related to an interest area may have a disproportionately large causal influence on subsequent judgments. This non-classical weighting and context-dependency are precisely the phenomena that quantum probability models are designed to capture, as they account for uncertainty and interference effects.[5] Collaboration with Dr. Busemeyer would enable the rigorous testing of this synthesis of quantum dynamics (Thrust B) and neurodiversity characteristics (Thrust D).

VI. Conclusion: Synthesis and Next Steps

This report has identified key Principal Investigators and provided actionable contact information, establishing a foundation for advanced research collaboration across three critical, overlapping domains: the theoretical physics of consciousness (IIT), non-classical cognitive modeling (Quantum Cognition), and translational neurodynamics (Complex Systems in ASD).

The analysis systematically demonstrates that researchers at the forefront of these fields—including Giulio Tononi, Christof Koch, Jerome R. Busemeyer, Jonathan Touboul, Vinod Menon, Kaustubh Supekar, and Damian Milton—share a core methodological imperative: the necessity of complex systems modeling to transcend the limitations of classical and time-averaged approaches.

Primary Actionable Recommendations

The highest priority outreach targets, offering the clearest path to rapid publication and high-impact grant funding (e.g., NIH R01s or U-awards), are:

1. **Dr. Jerome R. Busemeyer (Indiana University):** His confirmed need for scalable computational solutions to the parameter explosion in quantum models presents an immediate, high-value technical contribution that secures a strong co-PI role.
2. **Drs. Kaustubh Supekar and Vinod Menon (Stanford University):** Their empirical validation that dynamic analysis is essential for clinical biomarker discovery in ASD provides a clear translational research agenda. The computational role would be to provide the necessary dynamic analysis (e.g., RQA, Lyapunov exponents) to quantify the specific forms of network rigidity they identified.

The ultimate strategic goal is the computational unification of these fields: applying the principles of complex dynamics (Touboul) to model decision anomalies (Busemeyer) and link psychological constructs like Monotropism (Milton) to physical measures of integration (Φ, Tononi) validated by clinical biomarkers (Supekar/Menon). This comprehensive, multi-scale computational approach is essential for securing large, multi-year funding in the emerging field of complex cognitive systems.

Works cited

1. Integrated Information Theory of Consciousness | Internet Encyclopedia of Philosophy, accessed November 24, 2025, https://iep.utm.edu/integrated-information-theory-of-consciousness/
2. Integrated Information Theory - Center for Sleep and Consciousness, accessed November 24, 2025, https://centerforsleepandconsciousness.psychiatry.wisc.edu/integrated-information-theory/
3. Quantum-Like Bayesian Networks for Modeling Decision Making - Frontiers, accessed November 24, 2025, https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2016.00011/full
4. Quantum Cognition and Decision Notes - Jerome R. Busemeyer, accessed November 24, 2025, https://jbusemey.pages.iu.edu/quantum/Quantum%20Cognition%20Notes.htm
5. The Impact of Superposition Principle on Human Cognition: A Scoping Review - IJFMR, accessed November 24, 2025,

https://www.ijfmr.com/research-paper.php?id=27308

6. Aberrant dynamics of cognitive control and motor circuits predict distinct restricted and repetitive behaviors in children with autism - Stanford University, accessed November 24, 2025, https://med.stanford.edu/content/dam/sm/scsnl/documents/Supekar_2021_Nature_Communications_Aberrant%20dynamics.pdf
7. Faculty & Staff - UW Department of Psychiatry, accessed November 24, 2025, https://www.psychiatry.wisc.edu/faculty-staff/
8. Brain and Consciousness - Allen Institute, accessed November 24, 2025, https://alleninstitute.org/division/consciousness/
9. Home | RePORT, accessed November 24, 2025, https://report.nih.gov/
10. ClinicalTrials.gov: Home, accessed November 24, 2025, https://clinicaltrials.gov/
11. Jerome Busemeyer: Faculty: Directory - Department of Psychological and Brain Sciences, accessed November 24, 2025, https://psych.indiana.edu/directory/faculty/busemeyer-jerome.html
12. Jerome R. Busemeyer - Indiana University, accessed November 24, 2025, https://jbusemey.pages.iu.edu/
13. Predicting non-linear dynamics by stable local learning in a recurrent spiking neural network - eLife, accessed November 24, 2025, https://elifesciences.org/articles/28295.pdf
14. Jonathan Touboul - Mathematical Neuroscience Team - Google Sites, accessed November 24, 2025, https://sites.google.com/brandeis.edu/math-neuro/team/jonathan
15. Jonathan Touboul - Brandeis University - Overview, accessed November 24, 2025, https://scholarworks.brandeis.edu/esploro/profile/jonathan_touboul
16. Mathematical Neuroscience Team - Google Sites, accessed November 24, 2025, https://sites.google.com/brandeis.edu/math-neuro
17. Psychologist Profile: Damian Milton, PhD - American Psychological Association, accessed November 24, 2025, https://www.apa.org/education-career/k12/infusing-diversity/social-personality/psychologist-profile-damian-milton
18. Damian Milton - Wikipedia, accessed November 24, 2025, https://en.wikipedia.org/wiki/Damian_Milton
19. Me and Monotropism: A unified theory of autism - ResearchGate, accessed November 24, 2025, https://www.researchgate.net/publication/329936107_Me_and_Monotropism_A_unified_theory_of_autism
20. Christof Koch - Allen Institute, accessed November 24, 2025, https://alleninstitute.org/person/christof-koch/
21. Lawrence Fung MD PhD - Stanford Medicine, accessed November 24, 2025, https://med.stanford.edu/profiles/lawrence-fung
22. Team — Complex Systems Lab UPenn, accessed November 24, 2025, https://complexsystemsupenn.com/team
23. How to Find a P.I. for U.S. Grad School| Email Tips, Tools & Real Talk from Intl Students, accessed November 24, 2025,

https://www.youtube.com/watch?v=n2VJcfNf-3M

24. How to Find a Lab and Cold Emailing Tips: an IRB perspective | 2025, accessed November 24, 2025, https://www.tc.columbia.edu/institutional-review-board/irb-blog/2025/how-to-find-a-lab-and-cold-emailing-tips-an-irb-perspective/
25. Cognitive Profile in Autism and ADHD: A Meta-Analysis of Performance on the WAIS-IV and WISC-V - PMC - NIH, accessed November 24, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC11110614/
26. Particle Swarm Training of a Neural Network for the Lower Upper Bound Estimation of the Prediction Intervals of Time Series - MDPI, accessed November 24, 2025, https://www.mdpi.com/2227-7390/11/20/4342
27. Quantum probability and quantum decision-making | Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences - Journals, accessed November 24, 2025, https://royalsocietypublishing.org/doi/10.1098/rsta.2015.0100