NIH The BRAIN Initiative®

Pre-application Information and Technical Assistance Webinar: Brain-Behavior Quantification and Synchronization (BBQS)

Lizzy Ankudowich, Ph.D.

Program Officer

NIH BRAIN Initiative Team B (Neural Recording & Modulation/Technology Development & Human Studies)

BRAINBBQS@od.nih.gov | https://braininitiative.nih.gov

Lizzy.Ankudowich@nih.gov

Background for Brain-Behavior Quantification and Synchronization (BBQS)

“Brain in Action”

- BRAIN Initiative 2.0 reports
  - The BRAIN Initiative 2.0: From Cells to Circuits, Toward Cures
  - The BRAIN Initiative and Neuroethics: Enabling and Enhancing Neuroscience Advances for Society
    - Call for “more sophisticated methods of quantifying behavioral, environmental, and internal state influences on individuals.”
    - Call for “tools to analyze naturalistic (untrained) and trained behaviors” and “to assimilate and link brain recordings with behavior.”
- Understanding full complexity of behavior requires detailed, multidimensional analysis of a broad range of behaviors in the context of the environment.
- Tools are needed to measure the **full richness of complex behaviors** and **synchronize** them to neural activity with high spatial and temporal resolution.

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

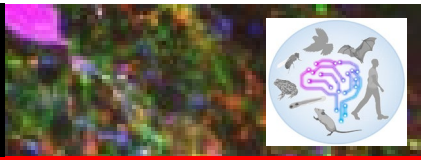
BBQS overarching objectives

- Development of tools for simultaneous, multimodal measurement of behavior within complex, dynamic physical and/or social environments and align these data with simultaneously-recorded neural activity.

- Development of novel conceptual and computational models that capture dynamic behavior-environment relationships across multiple timescales and that can integrate correlated neural activity into the model.

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

BRAIN Initiative: Brain Behavior Quantification and Synchronization (R61/R33 Clinical Trial Optional)



RFA-MH-22-240 (R61/R33): New funding opportunity announced 7/22/2022

- **Purpose:** Supports development and validation of next-generation tools, methods, and analytic approaches to **precisely quantify behaviors** and **combine them with simultaneous recordings of direct neural activity in humans**.
- Tools used for measuring and analyzing behavior should be **multi-modal**, with the appropriate accuracy, specificity, temporal resolution, and flexibility necessary for **integration with existing tools used to measure and modulate the brain circuits that give rise to those behaviors**.

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

RFA-MH-22-240 BBQS: Areas of focus

- Tools that advance novel methods to capture and quantify **multiple dimensions of behavior** in real time.
- Tools to advance **environmental sensing** (e.g., Internet of Things [IoT]) and/or to improve integration of contextual measures with measures of behavior.
- **Novel application and/or utilization of existing smart hardware technologies** (e.g., phones, wearable technology) to capture dynamic behavior and/or to integrate behavioral and physiological measures at the same time scale.
- **Less obtrusive, ambulatory devices that are wireless** (e.g., no backpack), that have longer term and **high storage capacity** (e.g., memory or power consumption that allows for sampling across days as opposed to intermittently) to achieve a **higher temporal resolution** and/or usage across temporal scales (e.g., from milliseconds to days).

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

RFA-MH-22-240 BBQS: Areas of focus

- Reliable tools that can **passively obtain objective measures** that accurately reflect or **predict subjective or internal mental states.**
- Novel approaches that **integrate passive measures of behavior with subjective reports of individuals' internal states** (e.g., subjective mood or cognitive state using ecological momentary assessments [EMAs]).
- Novel approaches to **integrate multiple data modalities and/or data streams** (e.g., integration of peripheral biophysiological measures with complex behaviors).
- Novel analytic tools and approaches (e.g., ML/AI methods) focused on behavioral quantification and/or novel conceptual or computational frameworks that incorporate integration/synchronization of multi-modal data streams.

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific application instructions

Research Strategy

- **Significance**
  - How the project will advance technological, methodological, computational approaches to characterize brain-behavior relationships and/or integrate behavior, environmental sensing and/or biophysiological measures.
  - How the project will advance understanding of how the brain gives rise to human behavior, cognition, or changes in internal states.
  - How the project will advance mechanistic understanding of brain-behavior relationships.

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific application instructions

Research Strategy

- **Investigators**
  - How the combined expertise of the research team supports/advances the critical elements of the research.
  - Explain how the combined team expertise is multidisciplinary, spanning behavioral science, computer/data science, ethics, and/or engineering.
- **Innovation**
  - How the project incorporates novel approaches, or advances existing approaches, to quantifying behavior, cognition, or changes in internal states.
  - Novel methods or approaches to integrate complex behaviors with neural data and/or biophysiological measures or information from the environment.
  - Relevant computational or conceptual frameworks used to integrate/synchronize multi-modal data streams.

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific application instructions

Approach

- **R61 Phase**
  - Goal: Support novel tool development (i.e., hardware/software) to enable or facilitate capture of quantifiable complex behavioral data, in real time, for subsequent integration with brain data.
  - How proposed tools will enable/facilitate capture of quantifiable complex behavioral data, in real time, for subsequent integration with neural data.
  - How new tools should overcome current limitations.

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific application instructions

Approach

- **R33 Phase**
  - Goal: Support the integration of tools developed in the R61 phase with approaches to measure brain activity in humans.
  - How the R33 phase integrates tools developed in the R61 phase with approaches to measure neural activity in humans.
  - R33 applications including a clinical trial component should describe development of next-generation closed-loop systems through incorporation of neurostimulation.

*Note also that proposed clinical trials must be mechanistic or Basic Experimental Studies involving Humans (BESH) studies that meet the NIH definition of a clinical trial.

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific application instructions

Approach

- **Milestones and timeline**
  - R61 Go/No-go criteria that will justify proceeding to the R33 phase
    - Clearly outlined (pre-specified) criteria for success of proposed tools and methodological approaches.
    - Defined in terms of outcomes achieved to demonstrate initial validation of proposed tools and feasibility of their integration with neural recording.
    - Objective, quantifiable, rigorously defined, feasible (in terms of the study timeline and approach), and scientifically justified.

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific application instructions

Approach

- **Milestones and timeline**
  - Study timeline must be commensurate with the scope of the proposed work
    - Work to be performed in the R61 phase has a flexible duration of 1-4 years.
    - Work to be performed in the R33 phase limited to the number of years necessary to demonstrate feasibility of simultaneously recording cognition/behavior and brain activity in humans (up to 2 years).

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific application instructions

Approach

- **Neuroethical considerations**
  - Because the responsible collection, storage, and use of these data can raise potential ethical challenges, a well-detailed description of how these considerations have been incorporated into the application is required.

***Note also that the inclusion of a neuroethicist on the team is required.**

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific application instructions

Approach

- **Resource Sharing**
  - An overarching objective of this FOA is to develop novel approaches to quantify complex behaviors in humans and integrate them with multi-modal data streams.
  - Quality assurance processes for data collection and annotation, open source/open sharing of developed resources, and dissemination should be described in the Resource Sharing Plan.

***Note that quality assurance processes for data collection, annotation, open source/open sharing, and dissemination are required.**

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific review criteria

Significance

- How will the proposed R61 and R33 projects contribute to the knowledge of human behavior, cognition, changes in internal states, or brain-behavior relationships?
- How will the proposed R33 project advance understanding of how the brain gives rise to human behavior, cognition, or changes in internal states; and/or advance mechanistic understanding of brain-behavior relationships?

Investigators

- To what extent does the proposed research include a multi-disciplinary team of researchers including complimentary expertise in neuroscience, behavioral science, computer/data science and/or engineering?

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific review criteria

Innovation

- How well does the proposed project advance approaches to quantifying behavior, cognition, or changes in internal states?
- How well does the proposed project incorporate novel approaches to integrate complex behaviors with neural data and/or biophysiological measures or information from the environment?
- To what extent does the proposed project advance computational or conceptual frameworks to integrate/synchronize neural and behavioral data and/or information from the environment?

Environment

- How well-suited is the environment and study team to developing novel approaches to collecting and integrating simultaneous behavioral and neural measures in humans?

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

FOA-specific review criteria

Approach

- To what extent are the **milestones** defining criteria for success of the R61 feasible and reasonable?
- To what extent is the study **timeline** feasible and commensurate with the scope of the work?
- In the **R33, how viable** is the plan to synchronize behavioral, neural, and/or peripheral or environmental measures?
- How appropriate are the **neuroethical considerations** of the proposed work?
- To what extent are the elements of the **Resource Sharing Plan** appropriate and well-described?

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

Plan for Enhancing Diverse Perspectives (PEDP)

- Inclusion of a **Plan for Enhancing Diverse Perspectives (PEDP)** is required
  - Through the PEDP, the BRAIN Initiative encourages the research community to consider how diverse perspectives advance the proposed specific aims and are integral to equity and inclusion in the science they perform.
  - Now a required component of most BRAIN Initiative funding opportunities.
  - Evaluation of the PEDP will be done during scientific review and programmatic review.
  - More information, including examples, can be found at https://braininitiative.nih.gov/about/plan-enhancing-diverse-perspectives-pedp

https://braininitiative.nih.gov/about/plan-enhancing-diverse-perspectives-pedp

Plan for Enhancing Diverse Perspectives (PEDP)

- **Plan for Enhancing Diverse Perspectives (PEDP)**
  - **Special review criteria**
    - Significance: To what extent do the efforts described in the PEDP further the significance of the project?
    - Investigators: To what extent will the efforts described in the PEDP strengthen and enhance the expertise required for the project?
    - Innovation: To what extent will the efforts described in the PEDP meaningfully contribute to innovation?
    - Approach: Are the timeline and milestones associated with the PEDP well-developed and feasible?
    - Environment: To what extent will features of the environment described in the PEDP (e.g., collaborative arrangements, geographic diversity, institutional support) contribute to the success of the project?

https://braininitiative.nih.gov/about/plan-enhancing-diverse-perspectives-pedp

Applications Not Responsive to the R61/R33 FOA

Studies that are not responsive to this FOA and will not be reviewed include:

- Incomplete applications using only the R61 mechanism or only the R33 mechanism.
- Applications that do not pre-specify objective criteria for success of proposed novel tools in the R61 milestones.
- Applications that do not include a timeline for proposed work.
- Studies involving technology development (e.g., in the R61 phase) that do not involve human testing (e.g., in the R33 phase).
- Studies only using non-human animals.
- Studies in the R33 phase that do not propose simultaneous recording of brain and behavioral data.
- Applications that do not both consider the potential ethical challenges of proposed work and include an ethicist.
- R33 clinical trial proposals that aim to develop a therapeutic intervention for a specific indication or disorder, such as a traditional feasibility clinical trial and/or a pivotal clinical trial.
- Applications that do not include a PEDP.

NIH BRAIN Initiative: Brain Behavior Quantification & Synchronization

- Application Deadlines: Feb 17, 2023 & Feb 15, 2024
  - Letter of intent due 30 days prior to deadline.
- Contacts: BRAINBBQS@od.nih.gov

https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html

NIH The BRAIN Initiative®

How to learn more about BBQS

- NIMH RFA RFA-MH-22-240: https://grants.nih.gov/grants/guide/rfa-files/RFA-MH-22-240.html (deadlines Feb 17, 2023 & Feb 15, 2024)
- Human Neuroscience Concept Clearance: https://www.nimh.nih.gov/funding/grant-writing-and-application-process/concept-clearances/2021/brain-research-through-advancing-innovative-neurotechnologiesr-brain-initiative-brain-behavior-quantification-and-synchronization
- Organismal Behavior Concept Clearance: https://nida.nih.gov/about-nida/advisory-boards-groups/national-advisory-council-drug-abuse-nacda/national-advisory-council-drug-abuse-nacda-approved-concepts#222_nih_brain
- 2022 BBQS Workshop videos, slides, and resources: https://event.roseliassociates.com/bbqs-workshop/
- NIH BRAIN Initiative Multi-Council Working Group Concept Clearance: https://videocast.nih.gov/watch=42301