

Intellectual Merit Criterion

Overall Assessment of Intellectual Merit

Very Good

Explanation to Applicant

Strengths: Addresses a technical need to simultaneously measure deep cortical areas optically and electrically in awake mice. Strong fundamental component: the research interrogates memory formation using a novel technology. Good explanation of potential problems and alternative strategies. Weaknesses: More detail regarding how the probe flexibility and insertion will be evaluated.

Broader Impacts Criterion

Overall Assessment of Broader Impacts

Very Good

Explanation to Applicant

Strengths: The applicant has a strong history of outreach, including a "sophomore surge" program during his undergrad, and he co-founded a company. The broader impacts have relevance to epilepsy and a better understanding of memory formation. Weaknesses: More details can be added to describe how the applicant will have discussions with other disciplines researching biophysical mechanisms underlying dendritic computation.

Summary Comments

This is a strong application from a student with direct experience in the proposed research to use arrays to measure brain activity and correlate this activity to memory formation. The applicant has a strong record of outreach that is likely to continue during graduate studies.

Intellectual Merit Criterion

Overall Assessment of Intellectual Merit

Good

Explanation to Applicant

Strengths This study is proposed to develop a novel microneedle array capable of mapping dendritic electrical activity and SWRs underlying memory formation. Currently, this is a challenging issue to realize the two functions simultaneously. If success, this tool will bring deeper insight in dendritic computations and memory consolidations. The student has rich research experience in this field since undergraduate period. The student has competitive GPA and already published a first-authored paper. He was also awarded a NIH T32 fellowship. Weaknesses The two Aims are not clear. It is not clear how to screen the optimal size and depth of the needle array for chronic and acute implantation. It is not clear how to analyze the data obtained from the in vivo implantation. How these data mean to the mapping and SWRs is not clear. The in vivo implantation and animal information are missing.

Broader Impacts Criterion

Overall Assessment of Broader Impacts

Very Good

Explanation to Applicant

Strengths If success, this study will bring new potential to study other neuroscience field and diseases. The student performed rich activities when he was at Montana State University. He participated or lead many mentoring programs for other incoming students. **Weaknesses** Besides publications and discussions with the collaborator, the proposed BI is not competitive.

Summary Comments

Generally, this proposal is a good proposal. The student has very rich research experience and participate and lead many programs for other students. The research plan lacks more clear details or very specific measure marks, which lessen the enthusiasm on its broader impact.

Intellectual Merit Criterion

Overall Assessment of Intellectual Merit

Excellent

Explanation to Applicant

The proposed technology for measuring SWR consolidation and somato-dendritic coupling is extremely novel and unique. The study design proposed to gather data using the platform during memory formation in a VR environment is well thought out in terms of its overall design and measurement of data and interpretation of results. What is unclear is how will it be clear that an animal using the VR device actually has formulated a memory if there is no known signature for memory formulation that can be collected. There may need to be a set number of iterations of the experiment that may need to be introduced where it is clear that there is an expectation of the reward and that key events are associated with the expectation of the reward. Quantifying expectation of reward via behavioral cues or data collected from the technology needs to have patterns indicative of memory formation and recall. The intellectual merit of the proposed effort is strong, the availability of the technology will enable collection of data which has otherwise not been possible. Having data collectable at this resolution and level will enable better understanding of working memory and other cognitive functions. Academic performance and contributions of science for this applicant is strong as indicated by awards, fellowship, publications/presentations, etc. This demonstrates the strong promise and potential of the applicant as a scientist/engineer.

Broader Impacts Criterion

Overall Assessment of Broader Impacts

Very Good

Explanation to Applicant

The broader impact resultant of this effort will stem a variety of areas not just knowledge to the neuroscience community, but knowledge of working memory and other cognitive functions in neurological disorders. The applicant has not emphasized the value of this data and results in the future in potentially being able to develop assistive technologies or interventions to improve quality of life in patients who suffer from neurological disorders. Impressive to have co-founded a company. A potential weakness is that the applicant comments on mentorship which is critical but more specific examples on how this is to be continued as they grow in their careers as this isn't highlighted with specificity as a future goal.

Summary Comments

The proposed effort is extremely novel and unique and has significant potential to generate a new technology and dataset that will provide a better understanding of working memory somatic body/dendritic level. The proposed study design is comprehensive, however, there are some aspects that need some expansion upon as referenced above. The results of this effort have groundbreaking potential, however, because no one has achieved what is proposed the experimental design considerations and data being collected and analyzed needs to be thoroughly detailed beforehand. The broader impacts and intellectual merit stemming from this effort will be significant if successful. The applicant has a significant educational background and foundation

as well as a set of experiences that will position them for success on this effort.