（様式 4）

国際共同研究事業
共同研究報告書

令和　4 年　4 月　20 日

独立行政法人日本学術振興会理事長　殿

［日本側代表者所属機関・部局］
国立研究開発法人理化学研究所・脳神経科学研究センター
［職・氏名］
チームリーダー マックヒュー・トーマス
［課題番号］
JPJSJRP　20181703

1. プログラム名　英国との国際共同研究プログラム（JRPs-LEAD with UKRI）

2. 研究課題名

（和文）記憶動態：システム記憶の神経基盤

（英文）Memory dynamics: the cellular signatures of systems memory

3. 共同研究実施期間（全採択期間）

平成31年　2月　14日　～　令和4年　3月　31日（　3年　2ヶ月）

4. 相手国側代表者（所属機関名・職名・氏名【全て英文】）

University of Bristol ・ Professor ・ Jones Matthew

5. 委託費総額（研究経費＋業務委託手数料等、返還額を除く）

本事業により執行した委託費総額		29,942,491　円
内訳	1年度目執行経費	330, 000　円
	2年度目執行経費	9,575,991　円
	3年度目執行経費	9,900,000　円
	4年度目執行経費	10,136,500　円
	5年度目執行経費	円
	6年度目執行経費	円

6. 共同研究実施期間を通じた参加者数（代表者を含む）

日本側参加者等	5 名
相手国側参加者等	4 名

7. 研究の概要・成果等

(1)研究概要（全期間を通じた研究の目的・実施状況）

What determines which of a brain's millions of neurons contribute to a given memory trace? How are those neurons interconnected, and how does that trace evolve with time and experience? How are those neurons engaged during memory consolidation and recall? Our overarching goal is to address these questions, which lie at the heart of systems neuroscience and, ultimately, hold the key the treating memory disorders.

(2)学術的価値（本研究により得られた新たな知見や概念の展開等、学術的成果）

An international collaboration project during the COVID pandemic has been extremely challenging on every level. Lab closures and the suspension of experiments impacted my lab in Japan for a brief period and the lab of my partner in the UK for a considerably longer time during FY2020 and FY2021. Nonetheless, we did make progress in generating new data and technical advances, establishing new physiological approaches in the lab, and using high density recordings to examine the lateralization of memory in the mouse hippocampus (Guan et al, 2021). The study on lateralization was a direct by-product of our attempts at conducting high-density recordings for this project and led to a recent paper published in Nature Communications. Moreover, in collaboration with Dr. Jones's lab in the UK we succeeded in using virus generating at RIKEN to label experience-dependent "engram" cells in the prefrontal cortex of the behaving rat, a novel achievement that will set the stage for future work on these projects.

(3)相手国との交流（本研究による国際共同研究の活性化や、両国の研究者が協力して学術交流することによって得られた成果）

The majority of this project occurred during the COVID19 pandemic, leading to many challenges in the personnel, research and especially, the exchange components of the project. The researcher initially hired by my UK partner lab, Dr. Eszter Komann, did visit Japan in January 2020, but had to cut her visit short due to the onset of the pandemic. Subsequent visits in both directions were postponed and ultimately cancelled due to the spread of the novel corona virus and travel restrictions imposed by the Japanese government. Likewise, planned in person collaboration meetings and progress reports, centered around the FENS meeting in Glasgow in early summer 2020, the JNS annual meetings in 2020 and 2021 in late summer and the SFN annual meetings in 2020 and 2021 were not possible. We did continue regular email communication and monthly zoom meetings and provided custom viral reagents prepared in our laboratory to Dr. Jones's lab in Bristol which they successfully integrated in their research.

(4)社会的貢献（社会の基盤となる文化の継承と発展、社会生活の質の改善、現代的諸問題の克服と解決に資する等の広い意味での社会的貢献はどのようにあったか）

Again, the limited in-person interaction permitted during the duration of the project made this goal extremely difficult to achieve.

(5)若手研究者養成への貢献(若手研究者養成への取組、成果)

Limitations on newly hired researchers and students entering Japan for the last 2 years were a significant hurdle in the training aspects of this grant. Nonetheless the pre-COVID portion of the project did allow Dr. Kormann to spend two months in my laboratory learning viral and mouse recording techniques. Further, in my laboratory this project contributed to the thesis work of an excellent Waseda University PhD candidate, Hefei Guan, and facilitated her completing her degree in 2021.

(6)将来発展可能性(本事業を実施したことにより、今後どの様な発展の可能性が認められるか)

This project has contributed to the establishment of several key approaches in my laboratory, including the use of high-density silicon probes (Cambridge Neurotech and Neuropixels), which will substantially contribute to future research efforts. Moreover, the collaboration with Dr. Jones's lab allowed us to transfer our viral engram labeling technology into the rat, which is a key advance for future memory studies in that model system. The manuscript we published in 2021 was the first to examine memory lateralization in the mouse hippocampus and creates a new paradigm to examine this phenomena moving forward.

(7)その他(上記(2)～(6)以外に得られた成果があれば記載してください)

As discussed above, successfully administering a large international collaboration focused on in person interaction and researcher exchange during an unprecedented global pandemic was extremely difficult. Given the severe constraints we faced in virtually every aspect we did our best to embrace new technologies and working styles to make the most of a challenging situation.

8. 今後の展望(今後の国際共同研究・協力体制の維持・発展に向けた展望について、具体性・実現可能性等を踏まえて、継続的に展開していくための計画を記載してください)

While the COVID19 pandemic forced us to temper expectations and progress for the majority of the project period, we did establish close scientific and cultural ties with our partners in the UK that will undoubtedly continue moving ahead. The travel restrictions demanded flexibility in our communication and research styles and while these were mostly detrimental, the expanded use of video chat and platforms for sharing large scale data and resources and positive developments that will speed international collaboration in coming years. I very much look forward to continuing and expanding on our collaboration in a future were travel and exchange are possible.

9. 最終年度実施状況

・ 最終年度実施計画書の「当該年度実施計画の概要」の内容と対応させつつ、最終年度のみの実施状況を簡潔に記載してください。再委託又は共同実施を行った場合は、それぞれの実施状況がわかるように記載してください。 ・ 当該年度又は前年度（複数年契約を締結し繰越を行った場合）の各費目における増減が研究経費総額の 50%（この額が 300 万円を超えない場合は 300 万円）に相当する額を超えた場合は、その理由と費目の内訳を変更しても計画の遂行に支障がないと考えた理由を記載してください。

During FY2021

Our focus has been on electrophysiological data collection and the implementation of new high density recording techniques. After production and procurement delays related to the COVID19 pandemic we were able to obtain probes from both Cambridge Neurotech and Neuropixels (IMEC) and have recordings in freely behaving mice have commenced. We have successfully established the surgical and engineering aspects of probe implantation and the initial data sets are being used to construct a custom analysis pipeline.

Although international travel continued to be impossible during the past year, regular meetings with Dr. Jones and his lab continued to share progress, data and experimental challenges. The research associate working on the project, Hefei Guan, has instrumental in establishing the high density recording approaches.

11. 研究発表（最終年度において、本共同研究の一環として本事業による支援を受けたことを明示して発表したもの（発表予定のものを含む）について記載してください）

〔雑誌論文〕 計（ 1 ）件　うち査読付論文 計（ 1 ）件

通番	共著の有無*1	著者名、論文標題等*2
1		Guan H, Middleton SJ, Inoue T, McHugh TJ (2021) Lateralization of CA1 assemblies in the absence of CA3 input. Nature Communications, 12, 6114, https://doi.org/10.1038/s41467-021-26389-3.
2		
3		

〔学会発表〕計（　）件　うち招待講演 計（ ）件

通番	共著の有無*1	発表者名、発表標題等*2
1		
2		

〔図　書〕 計（　）件

通番	共著の有無*1	著者名、著書名等*2
1		

*1 相手国側参加者との共著（共同発表）がある場合は〇と記入。

*2 当該発表等を同定するに十分な情報を記載すること。例えば学術論文の場合は、著者名、論文標題、雑誌名、巻号、発行年（西暦）、最初と最後の頁、掲載論文の DOI、学会発表の場合は発表者名、発表標題、学会等名、発表年（西暦）、発表地（国名、国外開催の学会の場合のみ）、図書の場合は著者名、著書名、出版社名、発行年（西暦）、総ページ数、ISBN、など（順番は入れ替わってもよい）。相手国側参加者との共著となる場合は、著者名が複数であっても省略せず、その氏名を記入し下線を付すこと。

*3 足りない場合は適宜行を追加すること。

12. 本事業による産業財産権の出願・取得状況（最終年度に出願又は取得したもの）

〔出　願〕　計（　）件

通番	産業財産権の名称、発明者、権利者、産業財産権の種類、番号、出願年月日、国内・外国の別
1	

〔取　得〕　計（　）件

通番	産業財産権の名称、発明者、権利者、産業財産権の種類、番号、取得年月日、国内・外国の別
2	

＊ 必要に応じて、欄を追加してください。