ANIMAL USAGE FORM

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AGENDA
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IACUC Use Only					
IACUC Study #	0512A78206	Approved:	2/23/06	Approval Duration:	
IACUC Chair:			RAR Veterinarian:		

Part A

0. Project Identification and Signatures

0A.Type of Application: ☐New Protocol ☒3-year Renewal of IACUC #0301A39921
(If this is a 3-year renewal, do not use language referring to the previous protocol or grant in this form.)

Anticipated Starting Date:	01/24/2006

0B. Project Title: (Project title must match grant title. If different, also provide grant title)

Encoding of Reach-to-Grasp in the Primary Motor Cortex
Neuronal Encoding of Power Versus Precision Grasp

0C. Is this an Agricultural Project? (Use of agricultural animals in non-biomedical research) ☐Yes ☒No

0D. Principal Investigator (Must be faculty or academic professional administrative staff.)

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U of M x.500 ID (ex. smith001): ebner001	University Department (if applicable): Neuroscience
Occupational Position: ☒Faculty ☐Staff (must be P & A) *Note: students cannot be principal investigator.*	

Principal Investigator Certification: If the IACUC approves my application, I agree to execute this work as described; request approval from the IACUC for changes; comply with the guidelines set forth by the IACUC and Research Animal Resources (RAR); follow Environmental Health and Safety guidelines; and be responsible for the supervision and work of my staff. If appropriate, this application accurately and completely reflects the animal use in the full grant application. The activities described in this study do not unnecessarily duplicate previous experiments.

[signature]	Professor and Department Head	12-13-05
Original Signature of PI	Title of PI	Date

If PI is not a University of Minnesota faculty member, IACUC may notify you that additional signatures will be required.

0E.Person preparing this document

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3. Specific Aims & Details of Animal Use

3A. What is the goal/specific aim of this project? What is the research or development question? Describe the relevance of the study to advancing scientific knowledge and/or the benefits of the study to human and/or animal health. Provide sufficient information to indicate that the potential new knowledge from the project justifies the use of animals. Jargon should be avoided or explicitly explained (please define all acronyms).

The global problem addressed by this proposal is how does the central nervous system (CNS) control a structure as complex as the primate hand? To begin to address this question, four Specific Aims are proposed that address three outstanding issues in the neural control of reach-to-grasp. The studies will use chronic single unit recordings in the primary motor cortex (M1) or cerebellum of monkeys trained to perform various reach-to-grasp movements. Extensive monitoring of arm and hand kinematics, grasp forces and the activity of arm and extrinsic/intrinsic muscles of the hand will be done. Statistical and analytical tools including regression analyses and data reduction techniques will be used to extract the neural representation of hand shape/object shape, kinematics, grasp forces and EMG activity. First, findings from psychophysical, lesion, and electrophysiological studies suggest that the CNS, at least in part, reduces the number of degrees of freedom by controlling the hand as a unit. Specific Aims 1 and 2 will address the hypothesis that neurons in the hand area of M1 encode and control hand shape/object properties, reflecting this global control of the hand. Second, early investigations into hand movements categorized prehension into two broad classes, power and precision grip and more elaborate classification systems followed. A prediction of these categorical schemes is that the CNS explicitly controls grasp type. More recent psychophysical studies, however, suggest that a strict division of hand posture into power and precision grasps does not occur. Specific Aim 3 will test the alternative hypothesis that power and precision are part of a continuum of hand postures in which hand shape is primarily controlled. A third major contemporary hypothesis is that reach and grasp are controlled by two independent but coupled channels: a "transport" channel that extracts information about the spatial location of objects to guide the reach and a "manipulation" channel that extracts information about the intrinsic properties of the object such as size and shape to guide hand shape. Although psychophysical results suggest that the two components are coupled, there is virtually no single unit data addressing this question. In Specific Aim 4 the hypothesis is tested that the reach and grasp components are coupled at the neuronal level in M1. In general understanding how the CNS controls prehension is a critical step in understanding human movements. In the future understanding the signals controlling grasp could prove useful for controlling prosthetic devices in patients with brain injury.

3B. If this application is a continuation of an ongoing project, please state concisely how these goals differ from those in the original application and what was accomplished during the prior approval period.

This application is a continuation of our long series of investigations into the role of the premotor and primary motor cortex. The original studies focused on understanding the parameters of reaching movements. More recently our emphasis has switched to reach-to-grasp movements. This is the focus of the latest renewal of our NIH grant funding this work. Accomplishments over the prior approval period including documenting how cortical neurons encode accuracy, speed, direction and force in both reaching and tracking tasks. A number of original and review papers have been published.

In the reach-to-grasp domain we have developed over the last several years the systems needed to study this behavior, undertook additional recordings in the motor cortex and cerebellum and analyzed the data. Also, the kinematics of reach-to-grasp were investigated, resulting in 2 journal publications. A research paper on the neural correlates of reach-to-grasp has also been published this year, with two additional manuscripts currently in preparation for publication. Our findings have shown thus far that reach, hand-shaping, and grasp force are controlled independently. A larger set of grasp objects have been developed in order to elicit greater variations in hand shaping during reach, including greater variations in power and precision grasp categories.

3C. Provide a complete and accurate description of what procedures will be performed on/with the animals. Answer in lay language or language understood by a person unfamiliar with your area of research (*define all acronyms*). Jargon should be avoided or explicitly explained. *Do not cut and paste from a grant proposal or include language or explanations that are not relevant to animal use.*

Provide sufficient detail to allow evaluation by the IACUC. You are strongly encouraged to use a diagram or chart to explain complex designs. **(Use additional pages if needed)**

- Describe all procedures, their frequency and time points over the course of the experiments. Be certain to detail the pain classification of each animal group. This should correspond to the information you provided in the **Animal Request Table** (Section 1).
- Include how long the animals will be maintained. Include dose, route of administration and frequency of any drugs to be administered.
- Describe methods used in behavior studies (including use of noxious stimuli or other methods of positive or negative reinforcement).
- Surgery should be described here only as it relates to the study design. Surgical details should be provided in Appendix F.
- For animals used in agricultural projects, you may reference the study code number of the IACUC approved Standard Operating Procedures for the housing facility and husbandry, as applicable.

These studies follow established methods for chronic recording single cells and reversible inactivation studies in behaving primates. Each animal is trained to perform controlled, reach-to-grasp over a period of 6-12 months. Once trained, chronic recording hardware is surgically placed on the skull. Over the next several months neurons in the primary cortex are recorded as the animal performs the tasks. Electromyographic (EMG) activity is recorded using EMG needle electrodes. At the end of the period of recording useful data, the chamber is removed, all wounds allowed to heal and in a second survival surgery a second chamber is placed. The kinematics of the hand and arm are monitored using non-invasive, video based motion analysis techniques. At the final stage of the study the animal is sacrificed for histological processing of the brain, determining recording locations. End point of study is when a sufficient number of cells have been recorded.

3D. For each species listed on the "Animal Request Table" in section 1, list your experimental and control groups. Indicate the number of animals in each and to which pain classification (A, B or C) they belong (a table format is highly recommended). The number of animals must add up to the total number of animals requested in section 1 and, if applicable, those discussed in Appendix B (breeding). This response should correspond to the response in question 3C.

Each of the 4 specific aims requires recording 100-150 neurons from 2-3 hemispheres. Therefore, we are requesting 8 animals in total.