************************************************************************** NOTICE OF GRANT AWARD **************************************************************************

RESEARCH Issue Date: 09/17/2004
Department of Health and Human Services
National Institutes of Health

NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS AND STROKE
**************************************************************************

Grant Number: 1 R01 NS050942-01 (Revised)
Principal Investigator: GROH, JENNIFER M PHD
Project Title: CRCNS: Integrative Information Processing

DIRECTOR
DARTMOUTH COLLEGE

OFFICE OF SPONSORED PROJECTS

HANOVER, NH 037551404
UNITED STATES
Award e-mailed to: sponsored.projects@Dartmouth.Edu

Budget Period: 09/01/2004 - 06/30/2005
Project Period: 09/01/2004 - 06/30/2008

Dear Business Official:

The National Institutes of Health hereby revises this award to reflect an increase in the amount of $237 (see "Award Calculation" in Section I and "Terms and Conditions" in Section III) to DARTMOUTH COLLEGE in support of the above referenced project. This award is pursuant to the authority of 42 USC 241 42 CFR 52 and is subject to terms and conditions referenced below.

Acceptance of this award including the Terms and Conditions is acknowledged by the grantee when funds are drawn down or otherwise obtained from the grant payment system.

Award recipients are responsible for reporting inventions derived or reduced to practice in the performance of work under this grant. Rights to inventions vest with the grantee organization provided certain requirements are met and there is acknowledgement of NIH support. In addition, recipients must ensure that patent and license activities are consistent with their responsibility to make unique research resources developed under this award available to the scientific community, in accordance with NIH policy. For additional information, please visit http://www.iedison.gov.

If you have any questions about this award, please contact the individual(s) referenced in the information below.

Sincerely yours,
Jeff Domanski
Grants Management Officer
NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS AND STROKE

See additional information below

SECTION I - AWARD DATA - 1 R01 NS050942-01 (Revised)

AWARD CALCULATION (U.S. Dollars):

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<td>Other Costs</td>
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Consortium/Contractual Cost: $95,627
Federal Direct Costs: $180,763
Federal F&A Costs: $65,421

APPROVED BUDGET: $246,184
TOTAL FEDERAL AWARD AMOUNT: $246,184

AMOUNT OF THIS ACTION (FEDERAL SHARE): +$237

Recommended future year total cost support, subject to the availability of funds and satisfactory progress of the project, is as follows:

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FISCAL INFORMATION:

CFDA 93.853

Document Number: RNS050942A

NIH ADMINISTRATIVE DATA:
PCC: LIUY SC / OC: 41.4A / Processed: DOMANSKIJE 040915 0850

SECTION II - PAYMENT/HOTLINE INFORMATION - 1 R01 NS050942-01 (Revised)

For Payment and HHS Office of Inspector General Hotline Information, see the NIH Home Page at

SECTION III - TERMS AND CONDITIONS - 1 R01 NS050942-01 (Revised)
This award is based on the application submitted to, and as approved by, the NIH on the above-titled project and is subject to the terms and conditions incorporated either directly or by reference in the following:

a. The grant program legislation and program regulation cited in this Notice of Grant Award.
b. The restrictions on the expenditure of federal funds in appropriations acts, to the extent those restrictions are pertinent to the award.
c. 45 CFR Part 74 or 45 CFR Part 92 as applicable.
d. The NIH Grants Policy Statement, including addenda in effect as of the beginning date of the budget period.
e. This award notice, INCLUDING THE TERMS AND CONDITIONS CITED BELOW.

(see NIH Home Page at http://grants.nih.gov/grants/policy/awardconditions.htm for certain references cited above.)

This grant is awarded under the terms and conditions of the Federal Demonstration Partnership Phase IV.

An unobligated balance may be carried over into the next budget period without Grants Management Officer prior approval.

This grant is subject to Streamlined Noncompeting Award Procedures (SNAP).

Treatment of Program Income:
Additional Costs

SECTION IV - NINDS SPECIAL TERMS AND CONDITIONS

Please note: This award has been revised to provide the correct amount of Total Costs (tuition remission and F&A adjustments).

Total direct funds (salary, fringe benefits and tuition remission) for the graduate student are provided at the NIH maximum allowable level of $35,568 per year as outlined in the NIH Guide for Grants and Contracts, February 5, 2004. http://grants.nih.gov/grants/guide/notice-files/NOT-0D-04-023.html

THE PREVIOUS TERMS AND CONDITIONS STATED BELOW REMAIN IN EFFECT

This grant has been selected under the NINDS plan to redistribute grant workload more evenly throughout the year. Consequently, the budget period reflects a 06/30/2004 end date. Subsequent budget periods will begin on 7/1, and will be for a 12-month duration. Although this grant will have a slightly shorter budget period this year, it is awarded the full 12-month level of funds for the budget period. Additional time may be requested at the end of the project period, if needed.

Note: Investigators receiving awards that start in April or May that are redistributed to February or March, or July and August that are redistributed to May or June, will have to submit the next competing continuation application one round earlier than before.

This award is funded by the National Institute of Neurological Disorders
and Stroke (NINDS). Any papers published under the auspices of this award must cite the funding support of the institute.

The program official is responsible for the scientific, programmatic and technical aspects of this project. The grants management specialist is responsible for the negotiation, award and administration of this project and for interpretation of grants administration policies and provisions. These individuals work together in overall project administration. Prior approval requests (countersigned by the PI & authorized business official) should be submitted in writing to the Grants Management Specialist. Requests may be made via e-mail provided they are routed through these same officials (listed below.) For additional information, you may access the NIH home page at http://www.nih.gov/ and the NINDS Home Page at http://www.ninds.nih.gov.

Future year non-competing continuation applications and other documents applicable to this grant should be submitted to:

Grants Management Branch
National Institutes of Neurological Disorders and Stroke
6001 Executive Boulevard, Suite 3390, MSC 9537
Rockville, MD 20852 (Express Mail)
Bethesda, MD 20892-9537 (Regular Mail)

Yuan Liu, Program Official
Phone: 301-496-3108  Email: yl5o@nih.gov  Fax: 301-402-1501

Gladys Melendez, Grants Specialist
Phone: (301)496-3929  Email: gb13y@nih.gov  Fax: 301-451-5635

SPREADSHEET
GRANT NUMBER: R01 NS050942-01 (Revised)

P.I.: GROH, JENNIFER M
INSTITUTION: DARTMOUTH COLLEGE

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NGA – NIH Query/View/Reporting System

F&A Cost Rate 2  59.90%
F&A Cost Base 2  0
F&A Costs 2  0

.......................END OF NGA.......................
individual(s) referenced in the information below.

Sincerely yours,

MICHAEL LOEWE
Grants Management Officer
NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS AND STROKE

See additional information below

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02  $220,038
03  $224,824
04  $231,865

FISCAL INFORMATION:

CFDA  93.853
Number:  
EIN:  EIN
Document Number: RNS050942A

NS/8426310/ 245,947/ 220,038/ 224,824/ 231,865

NIH ADMINISTRATIVE DATA:
PCC: LIUY SC / OC: 41.4A /Processed: LOEWEM 040827 0158

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http://www3.nia.nih.gov/Scope/sector.cfm?AgencyId=8827003&ProjectNumber=120

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http://www.84.105.60375920/05 vielleicht.html2010

http://www.74.7.129.221:8080/2010+pami/2010+pami
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1. TITLE OF PROJECT (Do not exceed 80 characters, including spaces and punctuation)

CRCNS: Integrative Information Processing

2. RESPONSE TO SPECIFIC REQUEST FOR APPLICATIONS OR PROGRAM ANNOUNCEMENT OR SOLICITATION ☑ NO ☑ YES (If "Yes," state number and title)

Number: NS 04-544
Title: Collaborative Research in Computational Neuroscience

3. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR

3a. NAME (Last, first, middle)
Groh, Jennifer M.

3b. DEGREE(S)
Ph.D.

3c. POSITION TITLE
Personal Info

3d. MAILING ADDRESS (Street, city, state, zip code)
Personal Info

3e. DEPARTMENT, SERVICE, LABORATORY, OR EQUIVALENT
Personal Info

3f. MAJOR SUBDIVISION
None

3g. TELEPHONE AND FAX (Area code, number and extension)
TEL: Personal Info

E-MAIL ADDRESS:
Personal Info

4. HUMAN SUBJECTS RESEARCH

4a. Research Exempt ☑ No ☑ Yes

4b. Human Subjects Assurance No.

4c. NIH-defined Phase III Clinical Trial ☑ No ☑ Yes

5a. If "Yes," IACUC approval Date
9/26/03

5b. Animal welfare assurance no.
A-325901

6. DATES OF PROPOSED PERIOD OF SUPPORT (month, day, year—MM/DD/YY)

From: 10/01/2004
Through: 09/30/2008

7. COSTS REQUESTED FOR INITIAL BUDGET PERIOD

7a. Direct Costs ($) 238,487
7b. Total Costs ($) 732,880

8. COSTS REQUESTED FOR PROPOSED PERIOD OF SUPPORT

8a. Direct Costs ($) 950,649
8b. Total Costs ($) 950,649

9. APPLICANT ORGANIZATION

Name: Personal Info
Address: Personal Info

Institutional Profile File Number (if known): Personal Info

10. TYPE OF ORGANIZATION

Public: ☑ Federal ☑ State ☑ Local
Private: ☑ Private Nonprofit
For-profit: ☑ General ☑ Small Business

11. ENTITY IDENTIFICATION NUMBER

EIN: Personal Info
DUNS NO. 04-102-7822
Congressional District: 2

12. ADMINISTRATIVE OFFICIAL TO BE NOTIFIED IF AWARD IS MADE

Name: Personal Info
Title: Personal Info
Address: Personal Info

Tel: Personal Info
E-Mail: Personal Info

13. OFFICIAL SIGNING FOR APPLICANT ORGANIZATION

Name: Personal Info
Title: Personal Info
Address: Personal Info

Tel: Personal Info
E-Mail: Personal Info

14. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR ASSURANCE: I certify that the statements herein are true, complete and accurate to the best of my knowledge. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if a grant is awarded as a result of this application.

SIGNATURE OF PI/PD NAMED IN 3a.
(If in ink, "Per" signature not acceptable.)

4/8/04

15. APPLICANT ORGANIZATION CERTIFICATION AND ACCEPTANCE: I certify that the statements herein are true, complete and accurate to the best of my knowledge, and accept the obligation to comply with Public Health Services terms and conditions if a grant is awarded as a result of this application. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties.

SIGNATURE OF OFFICIAL NAMED IN 13.
(If in ink, "Per" signature not acceptable.)

4/13/04
Integrating sensory information from a variety of sources to produce motor commands is fundamental to human behavior. Impairments in multisensory and sensorimotor integration impact numerous aspects of human health, ranging from social interactions and communication to movements in a complicated environment. For example, directing gaze to the location of a sound is a complex information processing task requiring the conversion of auditory input signals into motor commands to move the eyes. This process is impaired in human neglect patients. Here, we propose a joint computational and experimental approach to illuminate this problem. Specifically, we will investigate how information about sound location is encoded in the spike trains of neurons in primate inferior colliculus, auditory cortex, lateral intraparietal cortex, and superior colliculus when monkeys perform saccades to sounds. We will explore the nature of the response patterns as a function of sound location (Aim 1) and eye position (Aim 2). Of particular interest will be the shape of spatial sensitivity and the effects of eye position on spatial sensitivity. In addition to considering conventional types of spatial sensitivity, we will use novel computational tools to explore what information can be extracted from these response patterns and provide compact descriptions of the high dimensional data (Aim 3). We will also develop new computational techniques to improve the experimental methods, including adaptive sampling and interactive visualization (Aim 4). These aims will enhance our understanding of neural processing from sensory input to motor output.

The issues of multisensory and sensorimotor integration investigated here bear on a variety of neurological disorders such as those arising from stroke and other types of brain lesions. A better understanding of the transformation from sensory input to motor response will aid in identifying the pathophysiological substrates in neurological disorders with impaired sensorimotor integration.
# RESEARCH GRANT

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page Numbers</th>
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<tr>
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<tr>
<td>Description, Performance Sites, and Personnel</td>
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<tr>
<td>Table of Contents</td>
<td>3</td>
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<tr>
<td>Detailed Budget for Initial Budget Period (or Modular Budget)</td>
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<tr>
<td>Budget for Entire Proposed Period of Support (not applicable with Modular Budget)</td>
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<tr>
<td>Budgets Pertaining to Consortium/Contractual Arrangements (not applicable with Modular Budget)</td>
<td>8-14</td>
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<tr>
<td>Biographical Sketch – Principal Investigator/Program Director (<em>Not to exceed four pages</em>)</td>
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<td>Other Biographical Sketches (Not to exceed four pages for each – See instructions)</td>
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<td>Research Plan – See attached NSF proposal</td>
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- **Introduction to Revised Application** (*Not to exceed 3 pages*)
- **Introduction to Supplemental Application** (*Not to exceed one page*)

**A. Specific Aims**

**B. Background and Significance**

**C. Preliminary Studies/Progress Report**

- Phase I Progress Report (SBIR/STTR Phase II ONLY)
  
  *SBIR/STTR Phase I: Items A-D limited to 15 pages.*

**D. Research Design and Methods**

**E. Human Subjects**

- Protection of Human Subjects (Required if Item 4 on the Face Page is marked “Yes”)
- Inclusion of Women (Required if Item 4 on the Face Page is marked “Yes”)
- Inclusion of Minorities (Required if Item 4 on the Face Page is marked “Yes”)
- Inclusion of Children (Required if Item 4 on the Face Page is marked “Yes”)
- Data and Safety Monitoring Plan (Required if Item 4 on the Face Page is marked “Yes” and a Phase I, II, or III clinical trial is proposed)

**F. Vertebrate Animals**

**G. Literature Cited**

**H. Consortium/Contractual Arrangements**

**I. Letters of Support (e.g., Consultants)**

**J. Product Development Plan (SBIR/STTR Phase II and Fast-Track ONLY)**

**Checklist**

**Appendix** (*Five collated sets. No page numbering necessary for Appendix.*)

Appendices NOT PERMITTED for Phase I SBIR/STTR unless specifically solicited.

Number of publications and manuscripts accepted for publication (*not to exceed 10*)

Other items (list):
## Detailed Budget for Initial Budget Period

### Direct Costs Only

<table>
<thead>
<tr>
<th>Name</th>
<th>Role on Project</th>
<th>Type</th>
<th>Effort</th>
<th>% Effort</th>
<th>Inst. Base Salary</th>
<th>Dollar Amount Requested</th>
<th>Fringe Benefits</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jennifer Groh</td>
<td>Principal Investigator</td>
<td>Effort</td>
<td>% Effort</td>
<td>Base Inst Sal</td>
<td>7,836</td>
<td>2,841</td>
<td>10,677</td>
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<tr>
<td>Jennifer Groh</td>
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<td></td>
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<td>20,800</td>
<td>7,540</td>
<td>28,340</td>
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### Subtotals

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<th>Item</th>
<th>Amount</th>
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<td>SUBTOTALS</td>
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<tr>
<td>CONSULTANT COSTS</td>
<td></td>
</tr>
<tr>
<td>EQUIPMENT (Itemize)</td>
<td></td>
</tr>
<tr>
<td>SUPPLIES (Itemize by category)</td>
<td></td>
</tr>
<tr>
<td>Lab supplies and minor experimental equipment</td>
<td></td>
</tr>
<tr>
<td>TRAVEL</td>
<td>5,904</td>
</tr>
<tr>
<td>PATIENT CARE COSTS</td>
<td>4,500</td>
</tr>
<tr>
<td>INPATIENT</td>
<td></td>
</tr>
<tr>
<td>OUTPATIENT</td>
<td></td>
</tr>
<tr>
<td>ALTERATIONS AND RENOVATIONS (Itemize by category)</td>
<td></td>
</tr>
<tr>
<td>OTHER EXPENSES (Itemize by category)</td>
<td></td>
</tr>
<tr>
<td>Animal Costs: partial purchase costs of two monkeys</td>
<td>2,500</td>
</tr>
<tr>
<td>Animal Care Costs: ¼ of the cost of all monkeys</td>
<td>7,600</td>
</tr>
<tr>
<td>Publication Costs</td>
<td>2,000</td>
</tr>
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</table>

### Subtotal Direct Costs for Initial Budget Period

$87,768

### Consortium/Contractual Costs

- Direct Costs: $70,425
- Facilities and Administrative Costs: $28,160

### Total Direct Costs for Initial Budget Period (Item 7a, Face Page)

$186,353

**SBIR/STTR Only: Fee Requested**
### BUDGET FOR ENTIRE PROPOSED PROJECT PERIOD
### DIRECT COSTS ONLY

<table>
<thead>
<tr>
<th>BUDGET CATEGORY TOTALS</th>
<th>INITIAL BUDGET PERIOD (FROM FORM PAGE 4)</th>
<th>ADDITIONAL YEARS OF SUPPORT REQUESTED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2nd</td>
<td>3rd</td>
</tr>
<tr>
<td>PERSONNEL: Salary and fringe benefits: Applicant organization only:</td>
<td>65,264</td>
<td>67,593</td>
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<td>CONSULTANT COSTS</td>
<td></td>
<td></td>
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<tr>
<td>EQUIPMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUPPLIES</td>
<td>5,904</td>
<td>6,020</td>
</tr>
<tr>
<td>TRAVEL</td>
<td>4,500</td>
<td>5,000</td>
</tr>
<tr>
<td>PATIENT CARE COSTS</td>
<td>INPATIENT</td>
<td></td>
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<tr>
<td></td>
<td>OUTPATIENT</td>
<td></td>
</tr>
<tr>
<td>ALTERATIONS AND RENOVATIONS</td>
<td></td>
<td></td>
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<tr>
<td>OTHER EXPENSES</td>
<td>12,100</td>
<td>12,100</td>
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<td>SUBTOTAL DIRECT COSTS</td>
<td>87,768</td>
<td>90,713</td>
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<td>CONSORTIUM/CONTRACTUAL COSTS</td>
<td>DIRECT</td>
<td>70,425</td>
</tr>
<tr>
<td></td>
<td>F&amp;A</td>
<td>28,160</td>
</tr>
<tr>
<td>TOTAL DIRECT COSTS</td>
<td>186,353</td>
<td>178,451</td>
</tr>
</tbody>
</table>

**TOTAL DIRECT COSTS FOR ENTIRE PROPOSED PROJECT PERIOD** *(Item 8a, Face Page)*  
$732,880

**SBIR/STTR Only**  
Fee Requested

**SBIR/STTR Only: Total Fee Requested for Entire Proposed Project Period**  
(Add Total Fee amount to "Total direct costs for entire proposed project period" above and Total F&A/indirect costs from Checklist Form Page, and enter these as "Costs Requested for Proposed Period of Support on Face Page, Item 8b.)

$[

**JUSTIFICATION.** Follow the budget justification instructions exactly. Use continuation pages as needed.

*Please see attached.*
Jennifer Groh We request 100% of salary support for Jennifer Groh to allow her to remain free of teaching obligations in the summer months to concentrate on conducting the research and overseeing the training of undergraduates and graduate students. Summer is a particularly productive time for involving undergraduates, when they are not busy with coursework.

Support of undergraduate researchers: We are requesting support for undergraduates to work in the Groh laboratory in the summer. Many qualified students lack the financial resources to work as volunteers; it is therefore critical to have stipend support available.

Annual salary increases are limited to 3% in accordance with NIH policy. The beginning fringe rate will be 36% and is projected to increase 1% each year effective July 1.

Supplies: We are requesting about half the cost of the supplies for the Groh laboratory. During the previous 12 month period, we spent $6,300 on electrodes (41 boxes at $154 per box, and about $3700 on biomedical supplies (gauze, syringes, antibiotics, surgical supplies). We anticipate that this rate of supply consumption will continue in the future, as the laboratory has reached a fairly steady pace of experimentation.

Other: This category covers our animal purchase and per diem costs. We currently have 7 animals; we anticipate buying one additional monkey at a cost of about $5000 during the period of the grant (this amount is pro-rated over the first two years). This animal will replace an existing animal in our colony. I am also requesting per diem support. Although proprietary info per diem rate of $10.73 per day for monkeys is on the high end compared to other institutions, a sizeable amount of this charge is waived for grant-supported research. I am requesting support to supplement this waiver and cover one quarter of the per diem costs. The total number of animals at our disposal should be sufficient for conducting the experiments.
proposed herein. Animals can be rotated between experiments, so that we are able to economize on the number of animals involved.

**Travel:** We are requesting funds for travel to [Personal Info] to attend the annual CRCNS PI.s meeting.
### DETAILED BUDGET FOR INITIAL BUDGET PERIOD
**DIRECT COSTS ONLY**

#### PERSONNEL (Applicant organization only)

<table>
<thead>
<tr>
<th>NAME</th>
<th>ROLE ON PROJECT</th>
<th>TYPE APPT. (months)</th>
<th>% EFFORT ON PROJ.</th>
<th>% Effort</th>
<th>INST. BASE SALARY</th>
<th>SALARY REQUESTED</th>
<th>FRINGE BENEFITS</th>
<th>TOTAL</th>
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<tr>
<td>Personal Info</td>
<td>Principal Investigator</td>
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<td></td>
<td></td>
<td>Base Inst Sal</td>
<td>24,450</td>
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<td>14,489</td>
<td>1,232</td>
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#### SUBTOTALS

|                      |             |               |                   |          |                   | 38,939           | 6,000           | 44,939     |

#### CONSULTANT COSTS

|                      |             |               |                   |          |                   | 1,800            |               |           |

#### EQUIPMENT (Itemize)

|                      |             |               |                   |          |                   | 4,000            |               |           |

#### SUPPLIES (Itemize by category)

| Supplies              | $800.00      | Publications  | $1000.00          |          |                   |                  |               |           |

#### TRAVEL

|                      |             |               |                   |          |                   | 19,686           |               |           |

#### PATIENT CARE COSTS

| INPATIENT             |             | OUTPATIENT     |                   |          |                   |                  |               |           |

#### ALTERATIONS AND RENOVATIONS (Itemize by category)

|                      |             |               |                   |          |                   |                  |               |           |

#### OTHER EXPENSES (Itemize by category)

| Tuition Remission     |             |               |                   |          |                   |                  |               |           |

### SUBTOTAL DIRECT COSTS FOR INITIAL BUDGET PERIOD

|                     |             |               |                   |          |                   | $70,425          |               |           |

### CONSORTIUM/CONTRACTUAL COSTS

| DIRECT COSTS         |             | MEETING       |                   |          |                   |               |               |           |

### SUBTOTAL DIRECT COSTS FOR INITIAL BUDGET PERIOD (Item 7a, Face Page)

|                     |             |               |                   |          |                   | $98,585          |               |           |

### SBIR/STTR Only: FEE REQUESTED

| PHS 398 (Rev. 05/01) | Page 10    | Form Page 4   |               |          |                   |                  |               |           |
## BUDGET FOR ENTIRE PROPOSED PROJECT PERIOD

**DIRECT COSTS ONLY**

<table>
<thead>
<tr>
<th>BUDGET CATEGORY TOTALS</th>
<th>INITIAL BUDGET PERIOD (from Form Page 4)</th>
<th>ADDITIONAL YEARS OF SUPPORT REQUESTED</th>
</tr>
</thead>
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<tr>
<td></td>
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<tr>
<td><strong>PERSONNEL:</strong> Salary and fringe benefits, Applicant organization only</td>
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<td><strong>EQUIPMENT</strong></td>
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<td><strong>SUPPLIES</strong></td>
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<td><strong>TRAVEL</strong></td>
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<td>4,000</td>
</tr>
<tr>
<td><strong>PATIENT CARE COSTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>INPATIENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OUTPATIENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ALTERATIONS AND RENOVATIONS</strong></td>
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</tr>
<tr>
<td><strong>OTHER EXPENSES</strong></td>
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<td>13,518</td>
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<td><strong>SUBTOTAL DIRECT COSTS</strong></td>
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<td>61,248</td>
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<td><strong>CONSORTIUM/ CONTRACTUAL COSTS</strong></td>
<td>DIRECT</td>
<td>F&amp;A</td>
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<tr>
<td><strong>DIRECT</strong></td>
<td>28,160</td>
<td>26,490</td>
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<tr>
<td><strong>TOTAL DIRECT COSTS</strong></td>
<td>98,585</td>
<td>87,738</td>
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</table>

**TOTAL DIRECT COSTS FOR ENTIRE PROPOSED PROJECT PERIOD (Item 8a, Face Page)** $368,593

**SBIR/STTR Only**

Fee Requested

**SBIR/STTR Only: Total Fee Requested for Entire Proposed Project Period**

(Add Total Fee amount to "Total direct costs for entire proposed project period" above and Total F&A/Indirect costs from Checklist Form Page, and enter these as "Costs Requested for Proposed Period of Support on Face Page, Item 9b.

JUSTIFICATION: Follow the budget justification instructions exactly. Use continuation pages as needed.
Principal Investigator/Program Director (Last, first, middle): Groh, Jennifer M.

CHECKLIST

TYPE OF APPLICATION (Check all that apply.)

[ ] NEW application. (This application is being submitted to the PHS for the first time.)
  [ ] SBIR Phase I  [ ] SBIR Phase II  [ ] SBIR Phase I Grant No. ______________________
  [ ] STTR Phase I  [ ] STTR Phase II  [ ] STTR Phase I Grant No. ______________________
  [ ] SBIR Fast Track
  [ ] STTR Fast Track

[ ] REVISION of application number:
  (This application replaces a prior unfunded version of a new, competing continuation, or supplemental application.)

[ ] COMPETING CONTINUATION of grant number: ______________________
  (This application is to extend a funded grant beyond its current project period.)
  [ ] No
  [ ] Yes. If "Yes," ______________________

[ ] SUPPLEMENT to grant number: ______________________
  (This application is for additional funds to supplement a currently funded grant.)
  [ ] No
  [ ] Yes. If "Yes," ______________________

[ ] CHANGE of principal investigator/program director.
  Name of former principal investigator/program director:

[ ] FOREIGN application or significant foreign component.

1. PROGRAM INCOME (See instructions.)
All applications must indicate whether program income is anticipated during the period(s) for which grant support is request. If program income is anticipated, use the format below to reflect the amount and source(s).

<table>
<thead>
<tr>
<th>Budget Period</th>
<th>Anticipated Amount</th>
<th>Source(s)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. ASSURANCES/CERTIFICATIONS (See instructions.)
The following assurances/certifications are made and verified by the signature of the Official Signing for Applicant Organization on the Face Page of the application. Descriptions of individual assurances/certifications are provided in Section III. If unable to certify compliance, where applicable, provide an explanation and place it after this page.

- Human Subjects; Research Using Human Embryonic Stem Cells
- Research on Transplantation of Human Fetal Tissue
- Women and Minority Inclusion Policy
- Inclusion of Children Policy
- Vertebrate Animals
- Debarment and Suspension
- Drug-Free Workplace (applicable to new [Type I] or revised [Type II] applications only)
- Lobbying
- Non-Delinquency on Federal Debt
- Research Misconduct
- Civil Rights (Form HHS 441 or HHS 690)
- Handicapped Individuals (Form HHS 641 or HHS 690)
- Sex Discrimination (Form HHS 639-A or HHS 690)
- Age Discrimination (Form HHS 680 or HHS 690)
- Recombinant DNA and Human Gene Transfer Research
- Financial Conflict of Interest (except Phase I SBIR/STTR) STTR ONLY: Certification of Research Institution Participation

3. FACILITIES AND ADMINISTRATIVE COSTS (F&A)/INDIRECT COSTS. See specific instructions.

[ ] DHHS Agreement dated: August 20, 2003
  [ ] No Facilities And Administrative Costs Requested.

[ ] DHHS Agreement being negotiated with ________________ Regional Office.
  [ ] No DHHS Agreement, but rate established with ______________________ Date

CALCULATION* (The entire grant application, including the Checklist, will be reproduced and provided to peer reviewers as confidential information.)

a. Initial budget period: Amount of base $50,738 x Rate applied 55.50% = F&A costs $28,160
b. 02 year Amount of base $47,729 x Rate applied 55.50% = F&A costs $26,490
c. 03 year Amount of base $48,937 x Rate applied 55.50% = F&A costs $27,160
d. 04 year Amount of base $50,103 x Rate applied 55.50% = F&A costs $27,807
e. 05 year Amount of base $ x Rate applied 0.00% = F&A costs $0.00

TOTAL F&A Costs $109,616

*Check appropriate box(es):

[ ] Salary and wages base
[ ] Modified total direct cost base
[ ] Off-site, other special rate, or more than one rate involved

Explanation (Attach separate sheet, if necessary):

4. SMOKE-FREE WORKPLACE [ ] Yes [ ] No (The response to this question has no impact on the review or funding of this application.)
BIOGRAPHICAL SKETCH

Provide the following information for the key personnel in the order listed on Form Page 2. Follow this format for each person. DO NOT EXCEED FOUR PAGES.

NAME
Jennifer M. Groh

POSITION TITLE
Assistant Professor

EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)

<table>
<thead>
<tr>
<th>INSTITUTION AND LOCATION</th>
<th>DEGREE (If applicable)</th>
<th>YEAR(s)</th>
<th>FIELD OF STUDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Princeton University</td>
<td>A. B.</td>
<td>1988</td>
<td>Biology</td>
</tr>
<tr>
<td>University of Michigan</td>
<td>M. S.</td>
<td>1990</td>
<td>Neuroscience</td>
</tr>
<tr>
<td>University of Pennsylvania</td>
<td>Ph.D.</td>
<td>1993</td>
<td>Neuroscience</td>
</tr>
<tr>
<td>Stanford University</td>
<td>Postdoctoral</td>
<td>1994-1997</td>
<td>Neurobiology</td>
</tr>
</tbody>
</table>

A. Positions and Honors

Positions
1997-present Assistant Professor, Department of Psychological and Brain Sciences, Center for Cognitive Neuroscience, Dartmouth.

Honors and Awards
1987 National Science Foundation summer research fellowship
1988 Summa cum laude degree in Biology, Princeton University
1988 Senior Book Prize in Biology, Princeton University
1988 Phi Beta Kappa
1988 Sigma Xi
1988 National Science Foundation Graduate Fellowship
1988 Rotary Fellowship (declined)
1988 University of Michigan Regents Fellowship (declined)
1989 National Defense Science and Engineering Graduate Fellowship
1992 Alfred N. Richards Predoctoral Fellowship in Biomedical Science
1994 Helen Hay Whitney Postdoctoral Fellowship
1994 Finalist, Donald B. Lindsley Prize in Behavioral Neuroscience
1994 Joanne S. Diamond Award Lecture in Behavioral Neurobiology, Duke University

B. Selected peer-reviewed publications


**Selected Abstracts (out of 37 total)**

C. Research Support:

Recently completed projects

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>The goal of this project was to evaluate the biological plausibility of the Groh &amp; Sparks models for coordinate transformations. Role: Principal Investigator</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Private Source</th>
<th>“Neural Coordinate Transformations” 1998-2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>The goal of this project was to assess the frame of reference of signals in the auditory pathway. Role: Principal Investigator</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Private Source</th>
<th>“Neural algorithms for sensor fusion”, 1999-2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>The goal of this project was to study how the computational transformations that auditory signals undergo before they can be fused with visual signals. Role: Principal Investigator</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Private Source</th>
<th>1999-2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>The goal of this project is to explore the neural substrates of multisensory integration. Role: Principal Investigator</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The goal of this project is to determine the shape of the eye position signal and explore the interactions between eye position and auditory signals in the auditory pathway. Role: Principal Investigator</td>
<td></td>
</tr>
</tbody>
</table>

Current support:

<table>
<thead>
<tr>
<th>Private Source</th>
<th>“Frames of Reference in the Auditory Pathway”, 2002-2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>The goal of this project is to explore the relationship between behavioral context and the form and nature of interactions between auditory and eye position signals in the auditory pathway. Role: Principal Investigator</td>
<td></td>
</tr>
</tbody>
</table>

NIH 5P50NS017778-22 “Program in Cognitive Neuroscience”, 1999-2004. The goal of this project is to assess the alignment of visual and auditory receptive fields in area LIP of primates.
BIOGRAPHICAL SKETCH

Provide the following information for the key personnel in the order listed for Form Page 2.
Follow the sample format for each person. DO NOT EXCEED FOUR PAGES.
OTHER SUPPORT:

GROH, J. M.:

ACTIVE:

Private Source (Groh):

"Frames of Reference in the Auditory Pathway"
Investigation of relationship between eye position signals and behavioral context

Dates & Amount
01/01/02-12/31/04
$215,000

Percent effort

NIH: 5P50NS017778-22 (Gazzaniga):
"Program in Cognitive Neuroscience"
Investigation of visual and auditory coding interactions in parietal cortex

Dates & Amount
08/01/99-7/31/04
$125,000

Percent effort

OVERLAP:

There is no overlap between any of the projects listed above and the experiments proposed here.
OVERLAP:
There is no overlap between any of the projects listed above and the work proposed here.
RESOURCES

FACILITIES: Specify the facilities to be used for the conduct of the proposed research. Indicate the performance sites and describe capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Under "Other," identify support services such as machine shop, electronics shop, and specify the extent to which they will be available to the project. Use continuation pages if necessary.

Personal Info

FACILITIES:

Laboratory:
Our laboratory consists of approximately 1200 square feet of space in rooms which is a state-of-the-art facility for research and education in psychology and cognitive neuroscience. In this space we have two complete alert monkey rigs housed in IAC single walled sound attenuation chambers lined with SONEX sound absorbent foam. Also in this space are an electronics workbench, monkey preparation area, and office space for technicians, postdoctoral fellows, and graduate students.

Animal:
Animals are housed in a vivarium within We have room to house up to 8 animals at a time. In addition, newly purchased animals undergo 10 week quarantine in one of the other animal facilities on campus. Surgeries are performed in a dedicated aseptic surgical suite This suite is equipped with a heart monitor, pulse oximeter, and a machine for delivering inhalant anesthesia such as isoflurane. This center is fully equipped to acquire, house, and treat monkeys. A clinical veterinarian heads the facility and a team of veterinary technicians staff the center for routine and emergency animal care. The housing and care conditions have met AAALAC accreditation standards.

Computer:
Each experimental apparatus contains two Pentium PCs with digital and analog interfaces for controlling lab equipment, delivering sensory stimuli, and monitoring animal behavior. We have 7 additional Pentium PCs devoted to offline data analysis and computational modeling, for a total of 11 computers in the lab. Data are stored on hard disk, tape, and CD for on and off-site storage.

Office:
The principal investigator has an office (approx. 150 square feet) Graduate students, postdoctoral fellows and technicians have office space within the laboratory.

MAJOR EQUIPMENT:

2 IAC single-walled sound attenuation chambers Shields animal from external noise.

2 Riverbend dual channel eye-tracking systems Monitors the horizontal and vertical rotation of eyes, ears, and/or head. Up to two body parts can be monitored simultaneously.

2 Narishige hydraulic microdrives Allows the advancement of individual electrodes into the brain with micron resolution. The range of fine adjustment extends up to 20 mm, plus there are several additional centimeters of coarse adjustment.
Auditory stimulus presentation systems: We have three systems for presenting auditory stimuli.

1. An adjustable array of 15 speakers. These speakers can be moved to any location on a horizontal crossbar that can be moved to any elevation between floor and ceiling height in front of the animal. The range of horizontal angles depends on the distance the subject is placed from this array, but typically spans the range of +/- 45 degrees. The software that controls the sounds generated by the speakers "balances" for individual differences between speakers.

2. A fixed array of 200 speakers, 20 wide by 10 high. This array is approximately 4 feet wide by 3 feet high. Angular locations of speakers depend on how far away from the array the animal is positioned. Again, the sound generation software takes into account inter-speaker variability to produce equivalent sounds from each speaker.

3. A rotating speaker-hoop. This device allows the positioning of a single speaker at a range of positions in the frontal hemifield of space. This device is not currently in use, but is available should the scientific need arise.

Visual stimulus presentation: We employ a variety of means of presenting visual stimuli.

1. An LED board is positioned behind the adjustable speaker array listed above (1). This LED board contains 480 LEDs (24 wide by 20 high), spaced at 2 inch intervals. In addition, the individual speakers in the speaker array have LEDs attached directly to them.

2. LEDs are also attached to the fronts of the individual speakers in the fixed speaker array described above (2).

3. A computer projector can be used to project any type of visual stimulus onto a white, acoustically transparent, screen placed in front of the fixed speaker array (2 above). This projector illuminates the testing room slightly; thus we do not plan to use it during data collection, but it can be useful during animal training.

Electrophysiological recording equipment:

2 sets of pre-amps, amplifiers, filters, and dual window discriminators (Bak electronics), plus 2 analog oscilloscopes. These are used for single-unit recording.

OTHER RESOURCES:

maintains electronics and machine shops.

provides secretarial support, photocopying, and access to a fax machine. All these resources are readily available for this project.
RESEARCH PLAN

A-D: See NSF proposal.

F. VERTEBRATE ANIMALS

All of the animal experiments outlined in this proposal will be performed using adult rhesus monkeys (*Macaca mulatta*), male and female, weighing between 5 and 15 kg. We use rhesus monkeys for several reasons. First, rhesus monkeys adapt easily to the behavioral training situations employed in our laboratory. They train well, are calm while sitting in a primate chair, and will perform steadily for several hours during daily experimental sessions. Secondly, we have extensive experience in locating and recording from the superior colliculus and nearby areas in rhesus monkeys. It therefore seems prudent to continue with this species since the success of the research depends critically on our ability to place microelectrodes in the appropriate areas. Finally, many behavioral experiments have shown that the macaque oculomotor system is an excellent model for human eye movements. Thus, our findings are likely to be directly applicable to understanding analogous sensorimotor processes in humans.

We will use a total of 8 animals for the experiments in this proposal. Each animal's tenure in the lab is approximately three years. Four or five of these animals will be in experimental use in any given time, two or three will be in training, and one will be held in reserve for unanticipated needs. This number of animals will be sufficient to permit simultaneous pursuit of three major projects throughout the course of this grant period.

For the most part, the way that we use the animals is transparent from the preceding descriptions of the projects. Here we add general procedural information that is not contained in the preceding pages. When an animal is in experimental use, it works in the context of an experiment or training session five days per week. At the beginning of the day, the monkey is led from its own cage using a pole and collar handling procedure. The monkey is weighed and then seated in a primate chair, and then works on a fixation task or a saccades task for 2-6 hours depending upon the demands of the experiment or training regime. The primate chair is adjustable along several critical dimensions so that a comfortable fit can be achieved for each animal. At the end of the experiment, the monkey is returned to its own cage. After several days of training, these procedures become routine for the animals and for the investigator. Gentle handling and a modicum of common sense go a long way toward establishing a good working relationship with each animal. It is useful to remember that a calm, non-threatening working environment is in the best interest of the animal and of the investigator who wishes to maximize the quality of the data produced.

Training is accomplished by operant conditioning techniques using positive rewards for desired behavior. No aversive conditioning is used in this laboratory. Our animals work for liquid reward (water or juice), and we therefore control water intake carefully. A minimum daily level of fluid intake for adequate hydration is established individually for each channel (judged during training), and supplemental fluid is given if the animal does not obtain its minimum during the experimental session. Extra fluid is provided on weekends. Hydration levels are monitored daily for each animal by measurement of body weight, assessment of skin turgor, and visual inspection of feces. These indicators are augmented as needed by measurement of urine specific gravity. We are careful to maintain our animals in a healthy but motivated state.

Surgical implantation of search coils and recording cylinders are the only procedures with the potential to cause pain or discomfort. These are accomplished with standard surgical techniques and are absolutely necessary since none of the proposed experiments can be performed without them. All surgical procedures are performed under surgical anesthesia (isoflurane) and aseptic conditions in an animal surgical facility administered by the Animal Resources Center. Post surgical analgesia is accomplished with valium or narcotics as necessary.
All animals are euthanized following termination of experiments. This is necessary so that we may reconstruct electrode tracks and confirm the locations of recording and stimulation sites within the cortex. Euthanasia is accomplished with an overdose of barbiturates administered intravenously, and conforms to guidelines established by the Panel on Euthanasia of the American Veterinary Medical Association.

The veterinary care of our animals is excellent. A clinical veterinarian with the Animal Research Center is on call 24 hours a day, and specialists are available for consultation. Daily husbandry is in the hands of trained employees of the Animal Research Center, but is supervised by myself and my coworkers.
CHECKLIST

TYPE OF APPLICATION (Check all that apply.)

☐ NEW application. (This application is being submitted to the PHS for the first time.)

☐ SBIR Phase I  ☐ SBIR Phase II: SBIR Phase I Grant No.  ☐ SBIR Fast Track

☐ STTR Phase I  ☐ STTR Phase II: STTR Phase I Grant No.  ☐ STTR Fast Track

☐ REVISION of application number:

(This application replaces a prior unfunded version of a new, competing continuation, or supplemental application.)

☐ COMPETING CONTINUATION of grant number:

(This application is to extend a funded grant beyond its current project period.)

☐ No  ☐ Previously reported

☐ SUPPLEMENT to grant number:

(This application is for additional funds to supplement a currently funded grant.)

☐ Yes. If "Yes," ☐ Not previously reported

☐ CHANGE of principal investigator/program director.

Name of former principal investigator/program director:

☐ FOREIGN application or significant foreign component.

1. PROGRAM INCOME (See instructions.)

All applications must indicate whether program income is anticipated during the period(s) for which grant support is requested. If program income is anticipated, use the format below to reflect the amount and source(s).

<table>
<thead>
<tr>
<th>Budget Period</th>
<th>Anticipated Amount</th>
<th>Source(s)</th>
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2. ASSURANCES/CERTIFICATIONS (See instructions.)

The following assurances/certifications are made and verified by the signature of the Official Signing for Applicant Organization on the Face Page of the application. Descriptions of individual assurances/certifications are provided in Section III. If unable to certify compliance, where applicable, provide an explanation and place it after this page.

- Debarment and Suspension; - Drug Free Workplace (applicable to new Type I or revised Type I applications only); - Lobbying; - Non-Delinquency on Federal Debt; - Research Misconduct; - Civil Rights (Form HHS 441 or HHS 690); - Handicapped Individuals (Form HHS 641 or HHS 690); - Sex Discrimination (Form HHS 659-A or HHS 690); - Age Discrimination (Form HHS 680 or HHS 690); - Recombinant DNA and Human Gene Transfer Research; - Financial Conflict of Interest (except Phase I SBIR/STTR) - STTR ONLY: Certification of Research Institution Participation.

3. FACILITIES AND ADMINISTRATIVE COSTS (F&A)/INDIRECT COSTS. See specific instructions.


☐ DHHS Agreement being negotiated with Regional Office.

☐ No DHHS Agreement, but rate established with Date

CALCULATION* (The entire grant application, including the Checklist, will be reproduced and provided to peer reviewers as confidential information.)

a. Initial budget period: Amount of base $87,768 x Rate applied 59.4 % = F&A costs $52,134

b. 02 year Amount of base $90,713 x Rate applied 59.9 % = F&A costs $54,337

c. 03 year Amount of base $91,292 x Rate applied 59.9 % = F&A costs $54,684

d. 04 year Amount of base $92,250 x Rate applied 59.9 % = F&A costs $56,614

e. 05 year Amount of base $ x Rate applied % = F&A costs $

TOTAL F&A Costs $217,769

*Check appropriate box(es):

☐ Salary and wages base  ☑ Modified total direct cost base

☐ Off-site, other special rate, or more than one rate involved (Explain)

Explanation (Attach separate sheet, if necessary): We are not charging any F&A costs on the subcontract amount.

4. SMOKE-FREE WORKPLACE ☐ Yes  ☑ No (The response to this question has no impact on the review or funding of this application.)