28) October 10, 2012 NIH eSNAP report of protocol.

OMB No. 0925-0001

| | |
|---|---|
| **Grant Number**<br>R01DC007177-09 | **Total Project Period**<br>From: 12/01/2004 To: 11/30/2014 |
| **EIN:** **Review Group:**<br>1396006492A1 AUD | **Requested Budget Period:**<br>From: 12/01/2012 To: 11/30/2013 |
| **Title of Project:**<br>Behavioral and physiological studies of sound localization | **Due Date:** 10/15/2012<br>**Submitted Date:** 10/10/2012 |
| **Program Director/Principal Investigator:**<br>Tom C.T. Yin<br>UNIVERSITY OF WISCONSIN<br>DEPT OF NEUROSCIENCE<br>1300 UNIVERSITY AVE<br>MADISON , WI 53706<br><br>**Phone Number:** Telephone #<br>**Fax Number:** Telephone #<br>**Email Address:** tcyin@wisc.edu | **Applicant Organization:**<br>UNIVERSITY OF WISCONSIN MADISON<br>UNIVERSITY OF WISCONSIN MADISON<br>21 N. Park Street, Room #<br>MADISON , WI 537151218<br><br>**Department:** PHYSIOLOGY<br><br>**Major Subdivision:** SCHOOL OF MEDICINE AND PUBLIC HEALTH (SMPH) |
| **Administrative Official:**<br>2ndary Personnel<br>Research & Sponsored Programs<br>21 N. Park St.<br>Room #<br>Madison , WI 53715<br><br>**Phone Number:** Telephone #<br>**Fax Number:** Telephone #<br>**Email Address:** Name @rsp.wisc.edu | **Signing Official:**<br>2ndary Personnel<br>Research & Sponsored Programs<br>21 N. Park St.<br>Room #<br>Madison , WI 53715<br><br>**Phone Number:** Telephone #<br>**Fax Number:** Telephone #<br>**Email Address:** Name @rsp.wisc.edu |
| **Human Subjects:** ☒ No ☐ Yes<br>**Research Exempt:** ☒ No ☐ Yes<br>**Exemption No:** **FWA Number:**<br>**Phase III Clinical Trial:** ☒ No ☐ Yes | **Vertebrate Animals:** ☐ No ☒ Yes<br>**Animal Assurance Number:**<br><br>**Inventions and Patents:** ☒ No ☐ Yes<br>☐ Previously Reported<br>☒ Not Previously Reported |
| **Program Income:** ☒ No ☐ Yes | |

| Budget Period | Anticipated Amount | Source |
|---|---|---|
| **F&A Changes:** | | |

| **Primary Project/Performance Site Location** | | |
|---|---|---|
| Organizational Name: BOARD OF REGENTS OF THE UW SYSTEM | | |
| DUNS: 161202122 | | |
| Street 1: UNIVERSITY OF WISCONSIN MADISON | Street 2: 21 N. Park Street, Room # | |
| City: MADISON | County: DANE | State: WI |
| Province: | Country: UNITED STATES | Zip/Postal Code: 537151218 |
| Congressional Districts: WI-002 | | |

| Additional Project/Performance Site Location | | | |
|---|---|---|---|
| Organizational Name: University of Wisconsin | | | |
| DUNS: 161202122 | | | |
| Street 1: 1300 University Avenue | | Street 2: | |
| City: Madison | County: Dane | | State: WI |
| Province: | Country: UNITED STATES | | Zip/Postal Code: 53706 |
| Project/Performance Site Congressional Districts: WI-02 | | | |

| Program Director/Principal Investigator: | Grant Number |
|---|---|
| Tom C.T. Yin | R01DC007177-09 |
| **Applicant Organization:** | **Period Covered by this Report:** |
| UNIVERSITY OF WISCONSIN MADISON | 12/01/2011 - 11/30/2012 |

**Title of Project:**

Behavioral and physiological studies of sound localization

**SNAP Questions:**

**Has there been a change in the other support of Senior/Key Personnel since the last reporting period?**

☒ No ☐ Yes

**Justification:**

**Will there be, in the next budget period, a significant change in the level of effort for the PD/PI or other Senior/Key Personnel designated on the Notice of Award from what was approved for this project?**

☒ No ☐ Yes

**Justification:**

**Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?**

☒ No ☐ Yes

**Justification:**

**Changes in Select Agent Research?** ☒ No ☐ Yes

**Changes in Multiple PD/PI Leadership plan?** ☒ No ☐ Yes

**Change in human embryonic stem cell (hESC) line(s) used?** ☒ No ☐ Yes

**Justification:**

**Human Subject Education Requirement:**

**Has the Involvement of Human Subjects changed since previous submission?** ☒ No ☐ Yes

**Has the Involvement of Animal Subjects changed since previous submission?** ☒ No ☐ Yes

**Publications:**

| Valid NIHMSID: | Citation ID: | Citation Source: | Citation Text: |
|---|---|---|---|
| Yes | 21414923 | PUBMED | Karino S, Smith PH, Yin TC, Joris PX. Axonal branching patterns as sources of delay in the mammalian auditory brainstem: a re-examination. J Neurosci. 2011 Feb 23; 31 (8) :3016-31. PubMed PMID:21414923; PubMed Central PMCID: PMC3157295. |
| | 15295015 | PUBMED | Tollin DJ, Populin LC, Yin TC. Neural correlates of the precedence effect in the inferior colliculus of behaving cats. J Neurophysiol. 2004 Dec; 92 (6) :3286-97. PubMed PMID:15295015. |

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|---|---|---|---|
| | 15483065 | PUBMED | Tollin DJ, Populin LC, Moore JM, Ruhland JL, Yin TC. Sound-localization performance in the cat: the effect of restraining the head. J Neurophysiol. 2005 Mar; 93 (3) :1223-34. PubMed PMID:15483065. |
| | 2504554 | PubMed Central | Batra R, Yin TC. Cross correlation by neurons of the medial superior olive: a reexamination. J Assoc Res Otolaryngol. 2004 Sep; 5 (3) :238-52. PubMed PMID:15492883; PubMed Central PMCID: PMC2504554. |
| | 2666401 | PubMed Central | Tollin DJ, Ruhland JL, Yin TC. The vestibulo-auricular reflex. J Neurophysiol. 2009 Mar; 101 (3) :1258-66. PubMed PMID:19129296; PubMed Central PMCID: PMC2666401. |
| | 2724336 | PubMed Central | Dent ML, Tollin DJ, Yin TC. Influence of sound source location on the behavior and physiology of the precedence effect in cats. J Neurophysiol. 2009 Aug; 102 (2) :724-34. PubMed PMID:19439668; PubMed Central PMCID: PMC2724336. |
| | 2807232 | PubMed Central | Tollin DJ, McClaine EM, Yin TC. Short-latency, goal-directed movements of the pinnae to sounds that produce auditory spatial illusions. J Neurophysiol. 2010 Jan; 103 (1) :446-57. PubMed PMID:19889848; PubMed Central PMCID: PMC2807232. |
| Yes | 18178351 | PUBMED | Moore JM, Tollin DJ, Yin TC. Can measures of sound localization acuity be related to the precision of absolute location estimates?. Hear Res. 2008 Apr; 238 (1-2) :94-109. PubMed PMID:18178351; PubMed Central PMCID: PMC2494532. |
| Yes | 16291937 | PUBMED | Tollin DJ, Yin TC. Interaural phase and level difference sensitivity in low-frequency neurons in the lateral superior olive. J Neurosci. 2005 Nov 16; 25 (46) :10648-57. PubMed PMID:16291937; PubMed Central PMCID: PMC1449742. |
| | 17188761 | PUBMED | Joris P, Yin TC. A matter of time: internal delays in binaural processing. Trends Neurosci. 2007 Feb; 30 (2) :70-8. PubMed PMID:17188761. |
| | 15190094 | PUBMED | Populin LC, Tollin DJ, Yin TC. Effect of eye position on saccades and neuronal responses to acoustic stimuli in the superior colliculus of the behaving cat. J Neurophysiol. 2004 Oct; 92 (4) :2151-67. PubMed PMID:15190094. |
| | 15069089 | PUBMED | Yin TC. Buried in the noise Focus on "temporal properties of responses to broadband noise in the auditory nerve". J Neurophysiol. 2004 May; 91 (5) :1934-5. PubMed PMID:15069089. |

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| **Cover Letter:**<br>File is not uploaded |
| **Research Accomplishments:**<br>File is not uploaded |
| **Other Document File:**<br>File is not uploaded |
| **Other Support File:**<br>File is not uploaded |

| All Personnel Report | | | | | | |
|---|---|---|---|---|---|---|
| **Program Director/Principal Investigator:** Tom C.T. Yin | | | **Grant Number** R01DC007177-09 | | | |
| **Name:** | **Commons ID:** | **Degree(s) Name:** | **SSN:** | | | |
| Tom C.T. Yin | | PHD, BOTH, MOTH | | **Months Devoted to Project** | | |
| **Role on Project:** | **Supplement Support:** | | **DoB:** (MM/YY) | **Cal** | **Acad** | **Sum** |
| PD/PI | | | | % Effo | | |
| **Name:** | **Commons ID:** | **Degree(s) Name:** | **SSN:** | | | |
| 2ndary Personnel | | PhD | | **Months Devoted to Project** | | |
| **Role on Project:** | **Supplement Support:** | | **DoB:** (MM/YY) | **Cal** | **Acad** | **Sum** |
| Research Associate | | | | % Effort | | |
| **Name:** | **Commons ID:** | **Degree(s) Name:** | **SSN:** | | | |
| 2ndary Personnel | | BS | | **Months Devoted to Project** | | |
| **Role on Project:** | **Supplement Support:** | | **DoB:** (MM/YY) | **Cal** | **Acad** | **Sum** |
| Technician | | | | % Effort | | |
| **Name:** | **Commons ID:** | **Degree(s) Name:** | **SSN:** | | | |
| 2ndary Personnel | | | | **Months Devoted to Project** | | |
| **Role on Project:** | **Supplement Support:** | | **DoB:** (MM/YY) | **Cal** | **Acad** | **Sum** |
| Technician | | | | % Effort | | |
| **Name:** | **Commons ID:** | **Degree(s) Name:** | **SSN:** | | | |
| 2ndary Personnel | | | | **Months Devoted to Project** | | |
| **Role on Project:** | **Supplement Support:** | | **DoB:** (MM/YY) | **Cal** | **Acad** | **Sum** |
| Sr. Info. Proc. Cons. | | | | % Effort | | |
| **Name:** | **Commons ID:** | **Degree(s) Name:** | **SSN:** | | | |
| 2ndary Personnel | | | | **Months Devoted to Project** | | |
| **Role on Project:** | **Supplement Support:** | | **DoB:** (MM/YY) | **Cal** | **Acad** | **Sum** |

| | | | | | |
|---|---|---|---|---|---|
| Programmer/Analyst | | | % Effort | | |

**Progress Report**

**a. Specific Aims**

There were three general specific aims: one was to test the hypothesis that the [redacted] Intellectual Property [redacted] two was to examine the [redacted]; and three was to study the [redacted] it with the well-known oculomotor circuit.

**b. Studies and results**

**Specific aim 1**: Considerable progress has been made on specific aim 1. We have developed a new training setup in which cats are [redacted] and then to [redacted] The position of head and gaze are monitored by a search coil which is centered at the head of the cat in the start box. The task is designed [redacted] that described by Lomber and his colleagues (Lomber and Malhotra, 2008) and we propose to cool the auditory cortex using the Lomber cryoloop cortical cooling technique. The hypothesis is that the cats [redacted] following cortical cooling of the primary auditory cortex. A substantial advantage of our behavioral setup is that the [redacted]. Lomber's system suffers from the necessity of two human experimenters needed to hold the cat in the start box and to deliver the reward from behind a screen.

Our preliminary observations using this new setup are very encouraging. So far two cats have been trained to [redacted] from one of four speaker locations (±30° and ±60°) along the horizontal plane. Trials were self-initiated when the cat's body and head were centered and [redacted]. Cats indicated their response by [redacted] lever at [redacted] to obtain a food reward. Reward was delivered only if the first attempt was correct. Trials without a response were classified as "no-go" trials while first selections at the wrong location were "incorrect". A non-categorized measurement of localization accuracy was obtained by [redacted] location. To provide variations in performance, we varied the stimulus duration from 25 to 1000 msec.

Localization performance under both speaker selection and initial gaze movement was [redacted]. Interestingly, for many of the incorrect and no-go responses, [redacted] to the correct sound source, [redacted] the correct target. [redacted] indicating target location, as [redacted]. At times, [redacted] Thus, [redacted] measurements of localization performance. Our data suggest that the [redacted] response provides a better measure of [redacted] especially [redacted] to specific targets. Apparently, a [redacted], suggesting more involvement in higher-order cognitive processing [redacted] as compared to [redacted]. An abstract has been submitted on this work [redacted] unpublished To our knowledge these are the first [redacted] made in animals [redacted] task.

**Specific aim 2**: The specific aim 2 has been placed on hold for the moment as our collaborator, Dr. [redacted] Name has moved from his position as [redacted] Title to take an adminstrative position as [redacted] Title

**Specific aim 3**: a post-doc in the lab, [redacted] Name has been attempting to record from the [redacted] located in the facial nucleus of two awake behaving cats. Accessing the facial nucleus has been problematic as it requires that the electrode be angled in the rostral-caudal dimension to avoid the bony tentorium. While we do not yet have definitive evidence of recordings [redacted] in these cats, we have encountered a [redacted] presumably located in the [redacted] Neuron with [redacted] to a broad band noise from a speaker directly in front of the awake cat as well as [redacted] have been recorded while the cat is awake and behaving. While it is disappointing that we [redacted], we believe that the proper angle of penetration will allow us to access the facial nucleus.

**Forward masking**: We have also initiated a new project headed by Name that combines behavior and physiology. The study examines the effect of a Intellectual Property in head unrestrained cats. Forward masking (FM) refers to the ability of a preceding masking sound to make a subsequent signal inaudible or difficult to detect. In our preliminary studies we have found that [redacted] than those under control conditions . We have [redacted] as well as the [redacted] of the signal. The [redacted] the cat, though in subsequent studies this could also be varied to examine the [redacted]

**Other projects:** In addition we are as usual working to publish several manuscripts of work that has been completed. One paper ( unpublished describing the [redacted] has been reviewed positively once at unpublished and the revised paper is about to be submitted again. This paper shows that cats [redacted] performance to [redacted]. Localization along the vertical dimension is [redacted]. Unlike human subjects, though, cats do not seem [redacted]. At least some of our cats [redacted] to a default position. These result reinforce the now prevalent idea that localization of sounds in the vertical dimension is dependent on the spectral properties imposed by the filtering of the HRTFs .

Another paper unpublished that we have been working on for some time has had a more difficult time with reviewers. This paper describes the [redacted] with the head unrestrained. In most trials in the cat [redacted] as a result of the VOR. The gaze movement is completed before the head movement, owing to the larger inertia of the head compared to the eyes, and this also results in the backward movement of the eyes in the head due to the VOR. However, the VOR must be [redacted] allow the gaze to shift.

A third paper unpublished that is nearly set to be submitted examines the effect of [redacted] and provides modeling data to help explain the [redacted] as described in human subjects. We first confirmed the [redacted] Computer simulations with a well-known auditory nerve model and [redacted] the above observations and to test several hypotheses. The simulation result indicated that [redacted] whereas neural integration that [redacted] at intermediate levels. The [redacted] be explained [redacted] and therefore, is likely a result of [redacted]

Several other studies are still on-going or are complete in terms of data collection but need considerable effort to complete the data analysis, generate the figures, and write up the results. These studies have been presented in recent years at the ARO meeting. An ongoing study involves creating a [redacted] We record the [redacted] from the cat while it is sedated and then [redacted] While there are several physiological studies using virtual sounds in anesthetized animals, there has not been any [redacted] that the HRTFs are recorded.

A completed study that is waiting to be written up examines the ability of cats to do a [redacted] in which an acoustic stimulus is delivered [redacted] The results show that cats [redacted] with an accuracy that is about equal to that [redacted]

A second study tracks the ability of cats to [redacted] Intellectual Property [redacted] in both external ears. Over a period of weeks, [redacted] to the distorted HRTF spectra.

Another study looked at the precedence effect for the head unrestrained cats for [redacted]. We found that sources displaced vertically [redacted] while those displaced diagonally usually [redacted] This is discussed in the context of the spectral cues resulting from the paired precedence effect stimuli.

**c. Significance**

Many of our experiments have direct parallels with psychophysical experiments in human subjects. For example, the localization with narrow band stimuli and results of perturbation of the HRTF are similar to results found in human subjects. It is gratifying that our results in cats are usually closely congruent with findings in humans, which lends support to our choice of an animal model that would closely mimic results in humans. Our physiological experiments cannot be replicated in human subjects but they are likely to reflect physiological processes in both species.

**d. Plans**

We do not anticipate any significant changes in our research plans. We plan to begin the cortical cooling project and to implant a cryoloop in a cat in the coming year. We will also continue our sound localization experiments as well as studying the neuronal circuitry underlying pinna movements.

**e. Publications**

**Abstracts**

Hong, Amy, Ruhland, Janet L., Gai, Yan and Yin, Tom C.T. Hearing through new ears: adaptation in sound localization in cats following ear canal perturbation. Assoc. Res. Otolaryngology Mid-Winter meeting, 35: 659, 2012.

Gai, Yan, Ruhland, Janet, and Yin, Tom C.T. A behavioral study of the precedence effect in cats under head-free conditions with speakers aligned in horizontal, vertical, and diagonal conditions. Assoc. Res. Otolaryngology Mid-Winter meeting, 35: 647, 2012.

[redacted] unpublished

[redacted] unpublished