Amendment Number 0001

Broad Agency Announcement 10-002

"Multidisciplinary University Research Initiative (MURI)"

1. The purpose of Amendment Number 0001 to BAA 10-002 entitled "Multidisciplinary University Research Initiative (MURI)", is to revise Topic Number 2 entitled, **"**Adaptive Cognitive Maps for Autonomous Systems" to correct the telephone number for the Topic Chief as follows:

Research Topic Chief: Dr. Thomas McKenna, ONR, **703-696-4503,** tom.mckenna@navy.mil

2. As a result, Topic Number Two is hereby deleted in its entirety and replaced with Attachment Number 1 entitled, "Topic Number 2 Adaptive Cognitive Maps for Autonomous Systems REV 1"

ONR FY2010 MURI TOPIC # 2 REV 1

Submit white papers and proposals to the Office of Naval Research

Adaptive Cognitive Maps for Autonomous Systems

Background:
Recent research has revealed that the brain's hippocampal and entorhinal systems provide an intrinsic metric of space and mechanisms to guide navigation and exploration of space. The entorhinal cortex contains "grid cells" which discharge when an animal is in a repeating set of locations within the environment, laid out in a hexagonal array. The grids are multi-scale and are capable of experience-dependent rescaling. The entorhinal neurons project to the hippocampus where neurons encode speed and the head angle as well as features of specific locations, such as visual landmarks and obstacles. This hippocampal place and heading representation is encoded in the phase precession of oscillations in this neural system Since these brain structures are also critical in memory processes, including episodic and trajectory memory, and integrate information from multiple cortical regions including polymodal association areas representing spatial and temporal context and highly specific information on item identity, this research has generated excitement on the prospects of characterizing the neural basis of cognitive maps.

Objective:
Identify the architectures and computational principles by which the parahippocampal region generates spatial representation, enables 2D and 3D navigation, and links visual imagery, landmarks, event memory and semantic information in cognitive maps.

Research Concentration Areas:

1) Non-linear dynamic models of the neural networks generating the grid cell representation of space and navigation.
2) Elucidation of the mechanisms by which visual inputs from the environment keep grid cell representations registered to the real world and how visual landmarks and objects are linked to spatial representations.
3) Computational models for navigation of autonomous systems based on the sensory and motor system links to the multi-scale parahippocampal grid and location networks.
4) Experimental and theoretical characterization of how the neuroscience of grid and place coding in the parahippocampal region informs human spatial representations, navigation and spatially linked semantic and visual information.

Impact:
A deeper understanding of natural neural-based spatial mapping and navigation would produce more robust approaches to robotic navigation and help bridge the semantic gap between geometric based robotic systems and human-level spatial reasoning. This will enable cognitively-compatible control and interaction of humans and autonomous systems, and robots capable of spatial cognition.

Research Topic Chief: Dr. Thomas McKenna, ONR, **703-696-4503**,
tom.mckenna@navy.mil