

George Mason University

**Center of Excellence in Neuroergonomics,
Technology, and Cognition (CENTEC)**

Interim Progress Report

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CONTENTS

1. Start of Project	1
2. Research	1
3. Training	2
3.1 Graduate Students in the Human Factors and Applied Cognition Program	2
3.2 Graduate Students in the Neuroscience Program	2
3.3 Graduate Students in the Bioinformatics Program	2
3.4 Research Assistants/Fellows	3
4. Collaborative Activities	3
4.1 Technical Exchanges at Conferences	3
4.2 Scientific Meetings at AFRL	4
4.3 CENTEC Inaugural Meeting at GMU	6
4.4 Other Ongoing and Planned GMU-AFRL Research Collaborations	7
5. Publications and Conference Presentations	8
5.1 CENTEC Member Publications	8
5.2 Special Issue of <i>NeuroImage</i> on “Neuroergonomics: The Brain in Action and at Work.”	11

1. Start of Project

George Mason University (GMU) received a Notice of Award from the Air Force Office of Scientific Research (AFOSR) on July 12, 2010. The award specified a period of performance of five years.

The Center of Excellence in Neuroergonomics, Technology, and Cognition (CENTEC) was officially launched at GMU on July 15, 2010. CENTEC is funded by the AFOSR and by the Air Force Research Laboratory (AFRL). Program Managers are Dr. Jun Zhang (AFOSR) and Dr. Morley Stone (AFRL).

CENTEC was chartered as an official Center at GMU on September 20, 2010. The web site for the Center is centec.gmu.edu.

This interim progress report describes research, training, and collaborative activities during the period from the start of the project, July 15, 2010 through December 8, 2010. Financial reports have been sent separately.

2. Research

There are 9 Project Areas within CENTEC, each with a GMU Project Leader. Each Project Area is also linked to associated project scientists at AFRL. The Project Areas and GMU Project Leaders are:

1. Molecular Genetic and Neuroimaging Studies of Complex Cognition (Parasuraman).
2. Trust in Automation and Cyberspace (Parasuraman).
3. Computational Analysis of Neural Mechanisms of Learning and Memory (Ascoli).
4. Emerging Cognitive Neuroimaging Technologies (Thompson).
5. Interruptions and Multi-Tasking (Boehm-Davis).
6. Auditory Cognition and Spatial Navigation (Baldwin).
7. Eye Movements, Attention, and Situation Awareness (Peterson).
8. Neuroadaptive Systems for Enhanced Training (Baldwin).
9. Neuroadaptive Automation Based on Transcranial Doppler Sonography (Shaw).

During this reporting period when CENTEC has been in the start up phase, GMU Project Leaders were engaged in identifying key research issues. Research activities within and across each of the 9 Project Areas have begun. Plans have been made for extensions of ongoing neuroergonomic research related to these areas. At the same time, the design of new studies has commenced, and data collection has progressed on experiments and modeling for each. The publications and presentations of CENTEC faculty and students that have resulted to date are listed at the end of this progress report in section 5.

In addition, Project Leaders in each area have met with AFRL personnel in discussions to identify mutual areas of interest and to plan for collaborative research. Such collaboration plans include all 9 Project Areas (see section 4).

3. Training

Several students and research assistants have been recruited and hired to receive training in neuroergonomics methods and to participate in one of the 9 CENTEC research projects. The personnel hired to date and their faculty advisors are listed below:

3.1 Graduate Students in the Human Factors and Applied Cognition Program

<u>Name</u>	<u>Faculty Advisor</u>
Brian Falcone	Raja Parasuraman
Andre Garcia	Carryl Baldwin
David Kidd	Carryl Baldwin
Ryan McKendrick	Raja Parasuraman
Nicole Werner	Deborah Boehm-Davis

Brian Falcone is working under the supervision of Raja Parasuraman on the effects of transcranial direct current stimulation (tDCS) on cognitive functioning. Andre Garcia spent the summer of 2010 working at AFRL on a project on EEG and team vigilance. He has since continued research under the supervision of Carryl Baldwin on topics related to EEG, driving, and simulator sickness. David Kidd is working on driver alarm research with Carryl Baldwin. Ryan McKendrick is working with Raja Parasuraman on studies examining the effectiveness of “emphasis change” as a training method for enhancing skill acquisition in dual tasks involving attention and working memory sub-tasks.

3.2 Graduate Students in the Neuroscience Program

<u>Name</u>	<u>Faculty Advisor</u>
Christopher Rees	Giorgio Ascoli
Ashley Safford	Jim Thompson

Christopher Rees is working under the supervision of Giorgio Ascoli on the use of advanced computing methods to characterize neuronal connectivity in the hippocampus. Ashley Safford is working with Jim Thompson on fMRI studies of attention and biological motion.

3.3 Graduate Students in the Bioinformatics Program

<u>Name</u>	<u>Faculty Advisor</u>
Robert Murphy	Karl Fryxell/Raja Parasuraman

Robert Murphy is working under the joint supervision of Karl Fryxell and Raja Parasuraman. He is currently being trained in both molecular genetic and cognitive testing methods.

3.4 Research Assistants/Fellows

<u>Name</u>	<u>Faculty Advisor</u>
Ryan McGarry	Pamela Greenwood
Lara Moody	Frank Krueger/Raja Parasuraman

Ryan McGarry is working under the supervision of Pamela Greenwood on studies examining the effects of different cognitive training methods (including video game training) on performance and brain connectivity (using diffusion tensor imaging). Lara Moody is working jointly with Frank Krueger and Raja Parasuraman on behavioral and fMRI studies of trust in human and machine agents.

4. Collaborative Activities

One of the goals of CENTEC is to foster research collaborations and scientific exchanges between GMU and AFRL. The following collaborative activities have taken place to date.

4. 1. Technical Exchanges at Conferences

4.1.1. The 1st International Conference on Neuroergonomics. This conference was held in Miami, FL, July 17-20, 2010, as part of the Applied Human Factors and Ergonomics Conference, and was attended by both AFRL and CENTEC members. There were six two-hour sessions on various topics in neuroergonomics research and practice, all of which were very well attended (standing room only). Ten faculty and students from GMU, all members of CENTEC, contributed to several of the sessions, as did several scientists from the Human Effectiveness Directorate (HED) of the 711 Human Performance Wing (HPW) of AFRL.

The following technical exchanges and collaborative activities took place:

(a) Prior to the start of the main conference, CENTEC Director Raja Parasuraman and AFRL-HPW member Glenn Wilson jointly directed a half-day tutorial on *Neuroergonomics Theory and Methods: Neural, Computational, and Genetic*, that attracted 16 fee-paying attendees. There was considerable interest generated among attendees regarding neuroergonomics techniques and their continuing development and application in CENTEC.

(b) CENTEC Director Raja Parasuraman and his group had productive interactions with AFRL-HPW Senior Scientist Joel Warm and his associates concerning new findings on cerebral blood flow and oxygenation in relation to vigilance performance. Drs. Warm and Parasuraman had one joint presentation and proceedings paper at the conference.

(c) CENTEC Project Leader Carryl Baldwin and her students discussed similarities and common findings from her work on EEG-based neuroadaptive systems for enhanced learning with AFRL scientist James Christensen and his group's research on real-time adaptive automation. Both technical areas depend on the use of artificial neural network methods for classification of operator states, as a result of which there was a productive exchange of information on these methods between the GMU and AFRL groups.

(d) CENTEC Director Raja Parasuraman and his group discussed brain stimulation techniques for enhancing cognition with Andy McKinley and his group at AFRL who are using transcranial Direct Current Stimulation (tDCS) and transcranial magnetic stimulation (TMS). CENTEC possesses a MagStim TMS system and is planning to acquire a tDCS system and to

begin a program of research on comparing the efficacy of brain stimulation to cognitive training techniques in enhancing skill acquisition. Raja Parasuraman is planning a visit to AFRL later in 2010/2011 to meet with Andy McKinley and his group to coordinate planning for such studies.

4.1.2. *Human Factors and Ergonomics Conference*. This conference was held in San Francisco, September 27 to October 1, 2010. In attendance were many CENTEC members and also several AFRL members, including CENTEC Director Raja Parasuraman and AFRL Senior Scientist Joel Warm. The technical exchanges that took place at the 1st *International Conference on Neuroergonomics* were continued. In particular, the plans for the special issue of *NeuroImage* on neuroergonomics (see section 5) were further discussed and finalized.

4.1.3. *Society for Neuroscience*. This large international conference, which took place in San Diego November 13-17, 2010, was attended by a few CENTEC members (Krueger, Parasuraman, Thompson, plus accompanying graduate students). While there were no CENTEC-AFRL meetings that took place, CENTEC Director Raja Parasuraman took the opportunity to meet with several prominent neuroscientists who attended the meeting to inform them of the establishment of CENTEC and of the Air Force's interest in this area as another example of translational neuroscience. He also met with some of the authors invited to submit a paper to the special issue of *NeuroImage* on neuroergonomics (see section 5). In addition, CENTEC member Giorgio Ascoli gave a demonstration at the conference that was illustrative of the use of advanced computational techniques that are also being examined in CENTEC projects. His presentation was entitled "Neurons on the Net," describing work on the "Hippocampone" project—a database of potential connectivity among neuronal classes in the rodent hippocampus—at the International Neuroinformatics Coordinating Facility booth.

4.1.4. *International Symposium on Aviation Psychology (ISAP)*. CENTEC Project Leader, Carryl Baldwin and AFRL Senior Scientist Joel Warm along with several AFRL scientists and CENTEC scholar Andre Garcia have submitted collaborative work to the ISAP conference to be held in Dayton, Ohio in May 2011.

4.2 Scientific Meetings at AFRL

During the period July 27-28, 2010, a group of 10 faculty and graduate students from CENTEC, including CENTEC Director Raja Parasuraman and project scientists Dr. Carryl Baldwin and Dr. Kenneth De Jong, visited the 711 HPW in Dayton, OH. The following activities took place.

July 27, 2010.

- (a) Drs. Paul Havig, Kristen Liggett and Eric Geiselman, and John McIntire presented their research on "Information Visualization and Interaction Techniques."
- (b) Dr. James Christensen presented research on adaptive interfaces involving real time assessment of operator cognitive state using EEG.
- (c) Drs. Ben Knott and Scott Galster discussed their team-based research "Cognitive Technologies for Teams", which incorporated design tools used to enhance team performance. GMU Ph.D. student and CENTEC member, Andre Garcia, also gave a presentation about his summer AFRL internship research working in this group, on "Team Vigilance".
- (d) Drs. Nandini Iyer and Brian Simpson gave a demonstration of their spatial audio research, which incorporated 3-D technology (i.e. a large sphere for presentation of

audio signals at 3-D locations). They illustrated the effectiveness of spatial 3-D audio cues in speeding response time during search for visual targets.

- (e) Drs. Dianne Popik and Victor Finomore discussed their research on a Multi-Modal Communications System that uses speech recognition software to convert audio to text for a more naturalistic communication interface.
- (f) Dr. John Schlager presented research on Nano-Toxicology and Molecular-Based Performance, involving the study of cellular pathways involved in cognitive functioning.
- (g) Dr. Andy McKinley closed the day with a presentation on his research on “Non-invasive Brain Stimulation to Accelerate Learning and Enhance Cognition”, which uses Transcranial Magnetic Stimulation (TMS) and, Transcranial Direct Current Stimulation (tDCS) as techniques to enhance cognitive functioning.

July 28, 2010.

CENTEC members gave presentations to a large group of AFRL scientists. The meeting was very well attended; in fact because of lack of space in the main conference hall, an overflow space with closed-circuit TV had to be provided for attendees who were unable to find a seat in the main room.

Dr. Morley Stone initiated the meeting by describing his efforts at AFRL at setting up a Center of Excellence in the field of Neuroergonomics. He expressed thanks to AFOSR and to Dr. Jun Zhang, Program Manager.

Dr. Raja Parasuraman then gave an overview of CENTEC and its major goals. He briefly described the nine major CENTEC project areas, the project leaders and associated investigators, and examples of the research issues involved in each project. He also emphasized that CENTEC was not just a research project but also involved training of graduate students and postdoctoral fellows in neuroergonomics techniques, as well as collaborations between AFRL and GMU personnel.

Three research presentations followed this overview talk. First, Dr. Parasuraman gave a talk on “Cognitive Superstars: Neural and Genetic Studies.” This presentation focused on the use of molecular genetic studies of cognitive functioning, with a focus on individuals with exceptional ability. This work falls within Project Area 1 in CENTEC, *Molecular Genetic and Neuroimaging Studies of Complex Cognition*.

Dr. Carryl Baldwin then talked on “Neuroadaptive Systems for Enhanced Learning.” She described her research on using real-time assessment of operator cognitive state using EEG and artificial neural networks. She then described this neuroadaptive system could be used to change the pace and presentation format during learning of a UAV task involving identification of specific targets. This research falls within Project Area 8 in CENTEC, *Neuroadaptive Systems for Enhanced Training*.

Finally, Dr. Kenneth De Jong gave a presentation on “Evolutionary Computation and Trust in Cyberspace.” He described his research on the use of evolutionary computation in addressing complex problems in computer and network security, and how this is related to the issue of trust in automated systems. This work falls within Project Area 2 in CENTEC, *Trust in Automation and Cyberspace*.

The meeting ended with a discussion of the presentations and of the previous day’s lab tours, between the AFRL and CENTEC scientists.

August 10, 2010.

Andre Garcia, a CENTEC member and a graduate student in the Human Factors and Applied Cognition (HFAC) Ph.D. program at GMU, gave a presentation at AFRL on his summer internship research conducted there. Mr. Garcia gave a well-regarded talk on “Team Vigilance: The Effects of Co-Action on Cortical Activity, Workload, and Stress.” This work was conducted under the direction of Ben Knott, Greg Funke, and Joel Warm at AFRL. Mr. Garcia, who received a Repperger Fellowship to spend the summer at AFRL, returned to GMU August 25, 2010 to continue his graduate studies and his participation in CENTEC. It is anticipated that other GMU students in the HFAC program will similarly spend time in AFRL labs in the summer of 2011 and beyond.

November 6, 2010.

Dr. Bill Kennedy was in the Phoenix/Mesa area for a meeting on computational social science and met with Dr. Glenn Gunzelmann of AFRL to discuss potential areas of mutual interest associated with CENTEC and cognitive modeling. Further discussions are planned.

November 16, 2010.

Project Scientist Dr. Matt Peterson (*Attention, Eye Movements, and Situation Awareness*) traveled to Dayton and met with AFRL scientists Drs. Benjamin Knott, Gregory Funke, and Victor Finomore at 711 HPW in Dayton, OH. They demonstrated current and past projects using eye tracking to assess situation awareness and workload during complex visual and multi-modal tasks.

December 8, 2010.

AFRL scientists Dr. Ben Knott and Dr. Greg Funke visited GMU and had further discussions with CENTEC Director Raja Parasuraman and Project Scientist Dr. Matt Peterson on the use of eye movements to assess situation awareness.



CENTEC Inaugural Meeting at GMU, September 14, 2010. Pictured, from left to right are AFOSR Program Manager Dr. Jun Zhang, AFRL Program Manager Dr. Morley Stone, CENTEC Director Dr. Raja Parasuraman, AFRL Human Effectiveness Director Dr. Jack Blackhurst, and AFRL Senior Scientist Dr. Joel Warm.

4.3 CENTEC Inaugural Meeting at GMU

The inaugural (kick-off) meeting of CENTEC was held at GMU September 13-14, 2010. This two-day event began on September 13 with tours of CENTEC lab facilities for about 20 visitors (from AFRL and other institutions). CENTEC Director Raja Parasuraman met the AFRL visitors at the Mason Inn hotel on the GMU campus and then escorted them to the CENTEC labs. The tour began with visits to three labs: 1) Driving simulator lab, (2) Neuroadaptive

learning lab, the Team UAV simulator lab. This was followed by a presentation on multi-modal neuroimaging. Subsequently, the visitors were taken for a tour of the robotics lab in the Engineering Building. The day ended with presentations by Dr. Sean Luke on the MASON simulation, an evolutionary computational modeling tool and by CENTEC member Dr. Bill Kennedy on the use of MASON in modeling the potential for conflict over scarce resources. A group of AFRL and CENTEC members then continued their interactions during a dinner that evening on the GMU campus.

The inaugural meeting continued on September 14 with a full day of presentations by CENTEC and AFRL members. Dr. Roger Stough, Vice President for Research and Economic Development at GMU, opened the meeting. He welcomed all and indicated that CENTEC should prove to be a major center for research and training at GMU. CENTEC Program Managers Dr. Morley Stone of AFRL and Dr. Jun Zhang then spoke briefly on the establishment of CENTEC, followed by CENTEC Director Dr. Raja Parasuraman who gave a historical overview of the development of the field of neuroergonomics. His talk concluded with a description of the project areas within CENTEC.

The morning and afternoon sessions then featured seven talks by CENTEC members:

- (a) Dr. James Thompson: “Emerging Cognitive Neuroimaging Technologies.” (Project Area 4)
- (b) Dr. Raja Parasuraman: “Molecular Genetics of Complex Cognition and Training.” (Project Area 1)
- (c) Dr. Giorgio Ascoli: “Neurocomputation, Learning, and the Hippocampus.” (Project Area 3)
- (d) Dr. Frank Krueger: “Neuroimaging of Human Trust.” (Project Area 2)
- (e) Dr. Bill Kennedy: “Cognitive Modeling of Trust between Agents and Humans.” (Project Area 2).
- (f) Dr. Matt Peterson: “Attention, Eye Movements, and Situation Awareness.” (Project Area 7).
- (g) Dr. Carryl Baldwin: “Neuroadaptive Systems for Enhanced Learning.” (Project Area 8).

The meeting ended with three presentations by AFRL scientists:

- (a) Dr. James Christensen: “Real-time Assessment of Cognitive State using Pattern Classification.”
- (b) Dr. Glenn Gunzelmann: “Modeling the Impact of Fatigue on Cognitive Processing.”
- (c) Dr. Andy McKinley: “Brain Stimulation, Learning, and Cognition.”

4.4 Other Ongoing and Planned GMU-AFRL Research Collaborations

4.4.1 CENTEC Project Leader, Carryl Baldwin and AFRL scientist Nandini Iyer are holding discussions and making plans for collaborative auditory research projects. Dr. Iyer visited the CENTEC auditory laboratories in summer 2010 and plans are being proposed to continue this exchange through a 3-month scientist in residence exchange where Dr. Iyer would conduct research in CENTEC at GMU.

4.4.2. CENTEC Project Leader, Carryl Baldwin and AFRL scientist Gregory Funke have exchanged data and numerous communications regarding physiological data collected by CENTEC scholar, Andre Garcia.

4.4.3 Other ongoing collaborations are listed in the Table below.

GMU	AFRL	Area	Ongoing/Planned
Giorgio Ascoli	Jeff Graham (AFRL DSRC)	Supercomputing Analysis of Hippocampal Neuromorphometry	Planned
Carryl Baldwin	James Christensen, Adaptive Interfaces Branch (RHCP)	EEG-based neuroadaptive systems	Ongoing
Carryl Baldwin	Nandini Iyer (RHCB)	Auditory cognition (RHCB)	Ongoing
Deborah Boehm-Davis	Paul Havig	Visualization (RHCV)	Planned
Deborah Boehm-Davis		Interruptions	Planned
Karl Fryxell	Tom Lampkin (RHPF)	Molecular genetic studies	Ongoing
Bill Kennedy	Robert Patterson	Cognitive Modeling	Planned
Raja Parasuraman	Andy McKinley (RHPF)	Brain Stimulation	Ongoing
Matt Peterson	Ben Knott	Eye movements	Ongoing
Tyler Shaw	Vic Finomore	Neuroadaptive automation	Ongoing
Tyler Shaw	Greg Funke	Team performance modeling	Ongoing

5. Publications and Conference Presentations

5.1 CENTEC Member Publications/Presentations

1. Baccus, W., Thompson, J.C. (June 2010). Contribution of body form and motion to responses to biological motion in MT+ and EBA depends on cue reliability. *17th Annual Meeting Human Brain Mapping Abstracts*.
2. Baldwin, C. L., Coyne, J. T., & Christensen, J. (2011, in press). EEG metrics of workload and learner engagement. In M. Fafrowicz, T. Marek, W. Karwowski & D. Schmorow (Eds.), *Neuroadaptive Systems: theory and applications*: Taylor & Francis/CRC Press.
3. Baldwin, C. L., Coyne, J. T., Roberts, D. M., Barrow, J. H., Cole, A., Sibley, C., Taylor, B., Buzzell, G. (2010). Prestimulus Alpha as a Precursor to Errors in a UAV Target Orientation Detection Task. In, W. Karwowski and G. Salvendy, (Eds.), *Applied Human Factors and Ergonomics*, Boca Raton, FL: Taylor & Francis.
4. Barrow, J. H., and Baldwin, C. L. (2010). Spatial audio vs. verbal directional cues: an examination of salience and disruptiveness within a simulated driving context. *In Proceedings of the International Community of Auditory Display*. (June, 2010, Washington, D. C.).

5. Barrow, J. H., and Baldwin, C. L. (2010). Allowing for Individual Differences in Auditory Warning Design: Who Benefits from Spatial Auditory Alerts? *In Proceedings of the Human Factors and Ergonomics Society Annual Conference*. (September, 2010, San Francisco, CA).
6. Clarke, E., Andrews, A., Espeseth, T., Parasuraman, R., & Greenwood, P. M. (2010). Visuospatial attention influences mental representation in working memory as reflected in the CDA. *Society of Neuroscience Abstracts*, 399.10/KKK66. Washington DC: Society for Neuroscience.
7. Coyne, J. T., Sibley, C., Cole, A., Gibson, G., Baldwin, C. L., Roberts, D., Barrow, J. (2010). Adaptive training in an Unmanned Aerial Vehicle: Examination of several candidate real-time metrics. In W. Karwowski and G. Salvendy, (Eds.), *Applied Human Factors and Ergonomics*, Boca Raton, FL: Taylor & Francis.
8. de Visser, E., & Parasuraman, R. (2010). Etiquette and the brain: Behavioral, computational, and neuroergonomic perspectives. In C. Hayes & C. Miller (Eds.), *Human-Computer Etiquette: Understanding the Impact of Human Culture and Expectations on the Use and Effectiveness of Computers and Technology*. (pp. 263-288). New York: Taylor & Francis.
9. de Visser, E., & Parasuraman, R. (2010). A neuroergonomic approach to human-computer etiquette and trust. In W. Karwowski & G. Salvendy (Eds). *Applied Human Factors and Ergonomics*. Boca-Raton: Taylor & Francis.
10. Fedota, J., McDonald, C. G., & Parasuraman, R. (2010). Modulation of conflict monitoring processes by stimulus ambiguity in an Eriksen flanker task: An event-related potential study. *Society of Neuroscience Abstracts*, 699.5/JJJ35. Washington DC: Society for Neuroscience.
11. Fedota, J., & Parasuraman, R. (2010). Neuroergonomics and human error. *Theoretical Issues in Ergonomics Science*, 11(5), 402-421.
12. Fu, S., Greenwood, P. M., Lin, M.-K., Wang, Y., Fryxell, K., & Parasuraman, R. (2010, November). CHRNA4 genotypes and visuospatial attention: An event-related potential study. *Society of Neuroscience Abstracts*, 198.9/III33. Washington DC: Society for Neuroscience.
13. Funke, M. E., Warm, J. S., Matthews, G., Finomore, Jr, V., Vidulich, M., Knott, B. A., Helton, W. S., Shaw, T. H., & Parasuraman, R. (2010). Static and dynamic discriminations in vigilance: Effects on cerebral hemodynamics and workload. In W. Karwowski & G. Salvendy (Eds). *Applied Human Factors and Ergonomics*. Boca-Raton: Taylor & Francis.
14. Garcia, A., Baldwin, C. L., & Dworsky, M. (2010). Gender Differences in Simulator Sickness In Fixed- versus Rotating-Base Driving Simulator. *In Proceedings of the Human Factors and Ergonomics Society Annual Conference*. (September, 2010, San Francisco, CA).
15. Garcia, A., Funke, M., Funke, G., & Warm, J. (2010). Team vigilance: The effects of co-action on vigilance. *Warfighter Enhancement Activities*, 4(1), 12.
16. Garcia, A., Funke, M., Funke, G., Knott, B., Finomore, V., Warm, J. S., Dukes, A., Kinsella, A., Nainaparampil, J., & Epling, S., (2010). Team vigilance: The effects of co-action on workload and vigilance. *Warfighter Enhancement Activities*, UCF IST ACTIVE Lab Newsletter, Expanded Edition 2010.
17. Kidd, D. G., Nelson, E. K., & Baldwin, C. L. (2010). The effects of repeated exposures to collision warnings on driving and secondary task performance. *In Proceedings of the Human Factors and Ergonomics Society Annual Conference*. (September, 2010, San Francisco, CA).

18. Gartenberg, D., & Parasuraman, R. (2010). Understanding brain arousal and sleep quality using a neuroergonomic Smart Phone application. In W. Karwowski & G. Salvendy (Eds). *Applied Human Factors and Ergonomics*. Boca-Raton: Taylor & Francis.
19. Kennedy, W. G. (2010). Towards understanding trust through computational cognitive modeling. In *Proceedings of the First International Conference on Biologically Inspired Cognitive Architectures*. November 13-14. Arlington, VA: American Association for Artificial Intelligence.
20. Krueger, F., Pardini, M., Huey, E.D., Raymont, V., Solomon, J., Lipsky, R.H., Hodgkinson, C.A., Goldman, D., Grafman, J (November 2010). The role of the met66 BDNF allele in the recovery of executive functioning following combat-related traumatic brain injury. *Society of Neuroscience Abstracts* Washington DC: Society for Neuroscience.
21. Landgraf, S., van der Meer, E., & Krueger, F. (June 2010). Cognitive resource allocation for neuronal activity underlying mathematical cognition: A multi-method study. *17th Annual Meeting Human Brain Mapping Abstracts*.
22. McCorry, D., & Thompson, J.C. (Nov 2010). Decoding covert speech states using functional magnetic resonance imaging and multi-voxel pattern analysis. *Society for Neuroscience Abstracts*. San Diego, CA: Society for Neuroscience.
23. Parasuraman, R. (2010). Neurogenetics of working memory and decision making under time pressure. In W. Karwowski & G. Salvendy (Eds). *Applied Human Factors and Ergonomics*. Boca-Raton: Taylor & Francis.
24. Parasuraman, R. (in press). Neuroergonomics: Brain-inspired cognitive engineering. In J. D. Lee & A. Kirlik (Eds.) *The Oxford Handbook of Cognitive Engineering. Volume 1: Foundations, Perspectives and Cognitive Issues*. New York: Oxford University Press.
25. Peterson, M.S., & Beck, M.R. (in press). Eye movements and memory. In I. Gilchrist & S. Everling (Eds.) *Oxford Handbook on Eye Movements*. Oxford, U.K.
26. Reinerman-Jones, Matthews, G., Warm, J.S., Langheim, L.K., Guznov, S., Shaw, T.H., & Finomore, V.S. (in press). The functional fidelity of individual differences research: The case for context-matching, *Theoretical Issues in Ergonomics Science*.
27. Safford, A.S., Hussey, E.A., Parasuraman, R., Thompson, J.C. (June 2010). Object-based attentional modulation of biological motion: Spatiotemporal dynamics using fMRI and EEG. *17th Annual Meeting Human Brain Mapping Abstracts*.
28. Shaw, T., Guagliardo, L., de Visser, E., & Parasuraman, R. (2010). Using Transcranial Doppler Sonography to measure cognitive load in a command and control task. In *Proceedings of the Annual Conference of the Human Factors and Ergonomics Society*, Santa Monica, CA: HFES.
29. Shaw, T. H., Parasuraman, R., Guagliardo, L., & de Visser, E. (2010). Towards adaptive automation: A neuroergonomic approach to measuring workload during a command and control task. In W. Karwowski & G. Salvendy (Eds). *Applied Human Factors and Ergonomics*. Boca-Raton: Taylor & Francis.
30. Tsai, Y.D., Kang, S., & Peterson, M.S. (September 2010). Effects of individual differences on visual search task performance. In *Proceedings of the Fifty-fourth Annual Meeting of the Human Factors and Ergonomics Society*. Santa Monica, CA: Human Factors and Ergonomics Society.
31. Wheeler, D., Rees, C., & Ascoli, G. A. (November 2010). The "Hippocampome", a database of potential connectivity among neuronal classes in the rodent hippocampus. *Society of Neuroscience Abstracts*. Washington DC: Society for Neuroscience.

Several additional publications are anticipated in 2011. Among these will be journal articles for a special issue of a journal, as indicated below.

5.2 Special Issue of *NeuroImage* on “Neuroergonomics: The Brain in Action and at Work.”

This special issue represents a key development relevant both to the research and collaboration goals of CENTEC. There is a strong need for a special issue on the topic in a high impact cognitive neuroscience journal. While neuroergonomics is increasingly well known in the human factors area, it is not yet well represented in the mainstream neuroscience literature.

Accordingly, CENTEC Director Raja Parasuraman made an initial inquiry to the editors of two high profile journals in cognitive neuroscience, *The Journal of Cognitive Neuroscience* and *NeuroImage* regarding the possibility of a special issue. Both editors were positive, but the first journal declined because they no longer publish special issues. The editor of the second journal, *NeuroImage*, was enthusiastically positive.

Following initial inquiries, discussions, and a review by the editor and publishers, the special issue is now planned for 2011, with 14 invited papers to be submitted by February 2011, and a publication date of about September 2011. An exciting aspect of the special issue is the agreement of Dr. Michael Posner to write a commentary article. Dr. Posner is particularly appropriate given that he is both a highly regarded pioneer of human performance research (e.g., Fitts & Posner, 1969) and is considered a “father” of the cognitive neuroscience revolution (Posner & Raichle, 1994).

The papers of the special issue will describe how research and practice in the field of human factors and ergonomics can be enriched by consideration of theories and results from neuroscience—in particular non-invasive neuroimaging, brain stimulation, molecular genetic, and computational techniques. In turn, the papers will show how neuroergonomics offers another example of translational neuroscience—as applied to normal populations engaged in work, transportation, and other everyday activities, as opposed to applications to clinical populations and medicine.

List of Invited Authors and Topics (CENTEC and AFRL contributors shown in **bold**; titles tentative).

1. **Raja Parasuraman, James Christensen**, and Scott Grafton, Special Issue Editors, Neuroergonomics: The human brain in action and at work.
2. **James Thompson and Raja Parasuraman**, George Mason University, Neuroimaging of attention and action observation.
3. Scott Grafton, University of California, Santa Barbara, fMRI/EEG and on-line control of action.
4. Miguel Eckstein and Barry Giesbrecht, University of California, Santa Barbara, Multimodal imaging and performance prediction.
5. **Raja Parasuraman**, George Mason University, and Yang Jiang, University of Kentucky, Individual differences in affect and cognitive performance: Neuroimaging and molecular genetic studies.
6. Mike Miller, University of California, Santa Barbara, Individual differences in brain structure and function and cognition.

7. **Andy McKinley** and Jeremy Nelson, Air Force Research Laboratory, TMS/tDCS and cognitive performance.
8. Yili Liu, Michigan, University of Michigan. Computational neuroergonomics.
9. Scott Makeig, University of California, San Diego, Mobile EEG in neuroergonomics.
10. **James Christensen and Glenn Wilson**, Air Force Research Laboratory, Real-time EEG classification of operator cognitive state.
11. **Carryl Baldwin**, George Mason University, Neuroadaptive EEG-based systems for enhanced learning in UAV tasks.
12. Vince Clark, University of New Mexico, Perceptual learning of concealed objects: A combined fMRI and tDCS study.
13. Scott Kerick and Kaleb McDowell, Army Research Laboratory, Aberdeen, Functional connectivity analysis of high-density EEG in a shooting task.
14. Vince Calhoun, University of New Mexico, Functional connectivity in simulated driving.
15. Michelle Voss and Art Kramer, University of Illinois, Urbana-Champaign, Effects of video game training on functional connectivity in attentional networks.
16. Michael Posner, University of Oregon, Commentary and historical overview.