Attending Graduate School, Funding Sources and Ergonomics Research

Helpful hints, requirements, and opportunities for you…
Why I Went to Graduate School (masters program):

- I thought it would be cool to be a professor!
- I was offered a research assistantship that would pay my tuition and provide a monthly stipend.
- It was an alternative to going to work right away.
- I was assigned to a project to study Space Shuttle maintenance operations at NASA KSC.
Some Issues I Encountered…

- My advisor had a high instructional load and little time for research project direction.

- The work commitment as part of my assistantship involved independent reporting to NASA employees.

- Advising on plans of graduate work through my department was not actively managed.

- Department faculty were not strong in my research area (ergonomics).
Outcomes:

- Eventually completed MS program with thesis.
- Applied to other IE graduate programs with more faculty in ergonomics to support PhD study.
- Accepted to highly-structured PhD program with reputable faculty in ergonomics and safety.
- Received fellowship from Air Force Office of Scientific Research for remainder of PhD program.
- Graduated with doctorate from department with strong reputation in research area.

(All is well that ends well...
Lessons to Convey:

☐ Select a graduate program with top faculty in your area.

☐ Make sure there are faculty with interest in supervising new graduate students and with time.

☐ Find out whether faculty are actively involved in executing their own research projects.

☐ Make sure department has dedicated director of graduate programs and system for managing plans of graduate work.

☐ If you are ultimately interested in doing a PhD, a thesis from a weaker MS program may not be considered demonstration of research propensity.
Practical Motivation for Graduate Study:

- Bachelors degrees are common:
  - 27.9% of population 25 yrs. and older has bachelors or higher (Census Bureau, 2010; [http://www.census.gov/prod/2012pubs/acsbr10-19.pdf](http://www.census.gov/prod/2012pubs/acsbr10-19.pdf))

- Masters degrees are not uncommon:
  - 10.3% of persons 25 yrs. and older have masters or higher (Census Bureau, 2010).

- Census Bureau (1/23/2013) recently reported fast growth in PhD and MS among degree holders…
  - From 2002-2012, population with doctorate grew by 45%.
More Practical Motivations…

- Financial and career opportunities:
  - Get your education paid for (scholarships, awards, assistantships, grants, corporate support (while working))
  - Increase your potential starting salary:
    - Median for IE 1 = $56.9K vs. median for IE 2 = $68.2K (see: http://www1.salary.com/Industrial-Engineer-II-salary.html)
    - Persons 25 yrs. and older with MS degrees earn ~$8K/year (~15% of income) more than persons with BS (Census Bureau, 2010).
  - Change career directions – Already working as entry-level IE and want to work as safety engineer/manager, for example.
  - Masters degrees are considered in promotions in industry and military (Military Times, 2009):
    - 42% of military officers have professional or doctoral degrees.
  - Graduate degree can accelerate progress along career path (enter industry as supervisor or receive promotion to management in half time of BS graduates; e.g., Volvo, 2012).
Scholarly Motivations for Graduate Study:

- **Learning:**
  - Develop greater knowledge about a specific aspect of your discipline.
  - Further prepare yourself for work in a specific area of ISE.
  - Gain an understanding of how to conduct research.
  - Create a platform for career in research and/or development.
More Reasons for Graduate Study:

☐ Ease of access:
  - Distance education programs are common, including degree-specific programs (e.g., MSIE, MSIMSE, etc.; see: http://engineeringonline.ncsu.edu/PS/grad_degrees.html)
  - On-line programs are available - NC State Engineering Online (http://engineeringonline.ncsu.edu/) is ranked #7 among online graduate engineering programs (USN&WR, 2013)

☐ High quality of programs:
  - Top-ranked programs recruit large number of students on annual basis (NC State Fall 2011 admissions: MS = 62; PhD = 14; Fall 2012: MS = 47; PhD = 14).
  - Departments with highly-ranked bachelors programs typically have highly ranked graduate programs...
    - Univ. of Michigan IOE – Undergrad. Ranking = 2; Graduate = 2.
    - NC State ISE – Undergrad. Ranking = 8; Graduate = 8 (see: http://www.engin.umich.edu/about/facts.html; USN&WR, 2013)
Basic Requirements for Masters Degrees, Typical Durations and Assistantships (at NCSU):

- **MIE** ([http://www.ise.ncsu.edu/graduate/mie-reqs.php](http://www.ise.ncsu.edu/graduate/mie-reqs.php)):
  - 33 credit hrs. (21 in ISE); one PhD-level course; can do project coursework up to 6 hrs. (not required); no minor.
  - Can complete in three semesters, if taking 9-12 hrs./term.
  - Applicants normally not considered for assistantships due to no research requirement.

- **MSIE** ([http://www.ise.ncsu.edu/graduate/msie-reqs.php](http://www.ise.ncsu.edu/graduate/msie-reqs.php)):
  - 30 credit hrs. (24 coursework); must do thesis at 3-6 hrs.; one PhD-level course; 9 hr. minor is required but can be interdisciplinary (e.g., mix of courses from BUS, CSC, PSY, ST).
  - Typically requires 2 yrs. to complete due to research project.
    - No proposal defense but oral defense at completion of research project.
  - Applicants are considered for teaching and research assistantships (TA/RA) in application review process.
    - TA slots are used to recruit top students, particularly those with strong English skills (high GRE-V, etc.).
Basic Requirements for PhD Degree, Typical Duration and Assistantships (at NCSU):

- **PhD** ([http://www.ise.ncsu.edu/graduate/phd-reqs.php](http://www.ise.ncsu.edu/graduate/phd-reqs.php)):
  - 72 hrs. beyond BS (39-42 in ISE)
  - Can apply 36 hrs. of native MS or 18 hrs. from non-native degree
    - Can apply up to 12 hrs. from distance education program.
  - Must do dissertation for 6 credit hrs. or more (typically 15 hrs.)
  - 15 credit hr. minor is required but can be interdisciplinary (e.g., mix of courses from BUS, CSC, PSY, ST).
  - Typically requires 3 yrs. beyond MS or 4-5 yrs. beyond BS:
    - Qualifying exam at end of first year.
    - Preliminary exam (proposal defense) in second year.
    - Final defense in third year.
  - Undergrads. with superior credentials may apply for/be admitted directly to doctoral program.
  - Applicants are considered for TA/RAs in application review process.
    - PhD applicants are given highest priority for department or RA funding.
Aspects of Applying for Graduate School (NCSU ISE):

- What needs to be included in an application:
  - GRE scores (V=150; Q=153; A=3) and GPAs (3.0/4.0)
  - Essay (or statement of purpose) and transcripts
  - Letters of recommendation and ratings (typically 3)

- What the admissions committee (Bernhard, Harrysson, Ivy, Kaber) is looking for…
  - Standard exam scores above criteria with strong quantitative performance (GRE-Q => 160).
  - GPA from top school => 3.25; non-top school => 3.5 (“borderline” GPA (3.0) from non-top school is concern).
  - Essay including expression of specific research interest in area (e.g., disease state modeling in health systems).
  - Good grades (limited number of “C” grades from non-top schools or few “D” grades from top school).
  - Letters ranking student in top 5-10% of class.

(Tradeoffs among qualifications are considered.)
General Costs and Some Forms of Funding Available for Graduate Study:

- **Spring 2013 tuition rates and fees:**
  - NC Residents: 9+ hrs. tuition = $3441.50; Fees = $1025.28
  - Non-residents: 9+ hrs. tuition = $9465.50; Fees = $1025.28

- **Awards/Fellowships:**
  - Graduate Merit Awards: $2500, $3759, $5000, $7500, $8000 and $10,000 to attract “high-quality graduate students” (~85/yr.).
  - Dean’s Doctoral Fellowships: Tuition, health insurance and stipend ($24K/yr.) for “high-quality doctoral students” (20/yr.).
  - Fitts Fellowships: Same as Dean’s Fellowship but administered within ISE Department (~4/yr.).
  - GEM (Graduate Degrees for Minorities in Engr.) Consortium: Provides tuition and fees + stipend (MS = $8K/yr.; PhD = $16K/yr.; number depends on applicants; see: [http://www.gemfellowship.org/gem-fellowship](http://www.gemfellowship.org/gem-fellowship))

- **Grants:**
  - Must prepare personal statement, description of previous research experience, and proposed plan of research (2 pgs. each).
Assistantships:

- **TAs:**
  - Students with superior credentials are recommended for TAs by the Graduate Admissions Committee.
  - Director of Graduate Programs (DGP; Fathi) selects students for TA offers and seeks approval from Dept. Head (Cohen).
  - Receive tuition, health insurance + stipend (~$1700/mon.)
  - Assigned to undergrad. or grad. class, typically with faculty working in area of interest.

- **RAs:**
  - Selected by faculty with research funding (from internal sources or external sponsorship – State/Federal agency).
    - Need to arrange for introductory meeting with faculty to identify research interests.
    - Provide CV for consideration for assistantship – Identify relevant experience.
    - Request interview – Should have background in area of research.
  - Typically receive tuition, insurance + stipend (amount varies depending on grant).
  - Assigned to faculty research project.
Graduate Student Support Plan (GSSP)

- Allows non-residents to pay in-state tuition rates.
  - Essentially reduces tuition charges to department, grant or fellowship program providing support for student.

- Any graduate student awarded an assistantship or fellowship may be eligible for GSSP:
  - 1st time enrollment or graduate GPA = 3.0.
  - Hold TA, RA or fellowship with stipend of at least $667.67/mon. (combined among sources).
  - Registered for full-time load and making progress towards degree (determined by DGP).

(See: http://www.engr.ncsu.edu/grad/tuition.php)
Student Support Specific to Ergonomics:

- NIOSH (National Institute for Occupational Safety & Health) Graduate Training Program:
  - Admission criteria is equivalent to department criteria (minorities are encouraged to apply).
  - 9-mon. stipend – currently between $1536-1836/mon.
  - 3-mon. summer research support or internship.
  - Tuition and health insurance during degree.
  - Support is provided for duration of degree program.

  For MS degree…
  - Follows ISE MSIE requirements and must include: ISE 540, 541, 544, 741, 744 or 745, 794 or 796.
  - Students also take PUBH 785 and ENVR 423 (offered by UNC).

  For PhD degree…
  - Follows ISE PhD requirements and must include courses identified above.
Focus on Cognitive Ergonomics Research:

Problem Identification
- Performance inefficiency
- Performance errors
- Accidents

Cognitive Risk Factors
- Workload
- Vigilance decrements
- Complacency
- Loss of situation awareness
- Skill decay

Solutions
- Cognitive work analysis
- Design of experiments
- Cognitive modeling and simulation
- Ecological interface design
- Human-centered automation design
- Collaborative/team research
Focus on Physical Ergonomics Research:

Problem Identification
Workplace injuries & diseases

Interventions
Job Screening
Training
Administrative Controls
Engineering Design
Designed Experiments

Epidemiological Risk Factors
Biomechanical
Physiological
Psychophysical
Ergonomics & Safety Courses taught through ISE:

- ISE 352 - Work Analysis & Design (F, SP)
- ISE 452 - Occupational Ergonomics (F, SP)
- ISE/PSY 540* - Human Factors in Systems Design (SP)
- ISE 541 - Occupational Safety Engineering (SP)
- ISE 543 - Musculoskeletal Mechanics (F)
- ISE 544* - Occupational Biomechanics (F, SP)
- ISE 639 - MS-level Directed Individual Study (SU)
- ISE/PSY 740 - Engineering Psychology of HCI (F - even yr.)
- ISE 741 - Systems Safety Engineering (F)
- ISE 742 – Environmental Stress, Physiology and Performance (Alt. yrs.)
- ISE/PSY 745 - Human Performance Modeling (F - odd yr.)
- ISE 767 – Upper-extremity Biomechanics (SP - odd yr.)
- ISE 768 – Spine Biomechanics (SP - even yr.)
- ISE 794B/PSY 710U - Cognitive Engineering (SP - even yr.)
- ISE 796 – Research Practicum in Human Factors/Ergonomics (F - even yr.)
- ISE 839 - PhD-level Directed Individual Study (SU)

* - Background courses for PhD qualifying exam.

Cross-listed courses taught through Psychology:

- ISE/PSY 743 - Ergonomic Performance Assessment
- ISE/PSY 744 - Human Information Processing
Teaching and/or Research Faculty:

- Nancy Currie (Ph.D., Univ. of Houston) – Visiting Assoc. Prof.
  - Teaching interests – Human factors, systems safety.

- Naomi Glasscock (Ph.D., NC State Univ.) – Lecturer
  - Teaching Interests – Ergonomics, usability evaluation, biomechanics.

- David B. Kaber (Ph.D., Texas Tech) - Professor
  - Research/Teaching Interests - Cognitive ergonomics, human-automation interaction, human interface design, system safety.

- Chang-Soo Nam (Ph.D. Virginia Tech) – Assoc. Professor
  - Research/Teaching Interests - Human factors, human-computer interaction, information engineering, rehabilitation.
Current Researchers & Assistants (13):

- Sang-Woo Bahn (Post-doc; NSF CAREER)
- Michael Clamann (PhD; NIOSH traineeship)
- Yi Chen (PhD; Dept. TA, ISE 352)
- In Cheol Choi (PhD; Nam Start-up)
- Brendan Corbett (MS; NC DOT & NIOSH traineeship)
- Karen Hicklin (Ph.D.; Dept. TA, ISE 452/540)
- Linus Jeon (PhD; NSF HCC & Dept. TA ISE 541)
- Jayoung Lee (MS; NSF CAREER)
- Yueqing Li (PhD; NSF CAREER)
- Shijing Liu (PhD; NSF CAREER)
- Wenqi Ma (PhD; NC DOT & Dept. TA, ISE 352)
- Carl Pankok (MS; NIOSH traineeship)
- Huseyin Sencan (PhD; Nam Start-up)
Recent Graduates and Theses (2011-12):

(PhD)

- Yu Zhang (PhD, 2011) – DENSO (Design Engineer)
  - “Visual and Cognitive Distraction Effects on Driver Behavior and an Approach to Distraction State Classification.”

- Biwen Zhu (PhD, 2011) – Monsanto Corporation (Usability Specialist)
  - “Assessing the Effects of Feedback Type and Modality on Motor Skill Learning and Human Motivation.”

(Masters)

- Will Heath (MS, 2012), Volvo Trucks (Manufacturing Engineer)
  - “An Assessment of Perceived Risk of Extension Ladder Set-Up Angles and Safety Label Effectiveness.”

- Meghan Rogers (MS, 2011) – Delta Airlines (Usability Researcher)
  - “Identifying and Evaluating Risk Factors for Musculoskeletal Disorders in Equine Veterinary Work.”

- Sameerajan Suresh (MS, 2011) – Human Interfaces, Inc. (Usability Specialist)
  - “Effects of Laptop Touchpad Texturing on User Performance and Usability Assessments.”

- Kinley Taylor (MS, 2011) – UNC-Chapel Hill (Systems Improvement Analyst)
  - “Identifying and Modeling Perceptions of Risk Factors in Hand Hygiene during Healthcare Operations.”

- Chad Uy (MS, 2011) – Design Science (Research Associate)
  - “The Effect of Handle Design on the Kinetics and Kinematics of a Pouring Task.”
Current Funding:

- “Haptic Simulation Design for Motor Rehabilitation and Skill Training”, NSF, 7/1/09-6/31/13, $670,205 (Kaber & Lee).
- “CAREER: WE FEEL SCIENCE: We Engage with the Flexible Experimental Environment for Learning in SCIENCE”, NSF, 9/1/10-8/31/15, $500K (Nam).
- “Field Evaluation of Double Crossover Diamond Interchanges”, Federal Highway Administration, 10/1/10-11/30/14, $721,098 (Hummer, Kaber & Rouphail).
- “A Pilot Study of Brain-Computer Interface (BCI)-Driven Orthosis for Rehabilitation”, UNC-NCSU Rehabilitation Engineering Center, 1/1/12-12/31/12, $24,961 (Nam & Goldberg).
- “Driver Behavior in Complex Navigation and Hazard Negotiation Under Distraction”, NC Department of Transportation, 7/1/12-6/30/13, $133,517 (Kaber, Hummer & Rasdorf).
- “North Carolina Education and Research Center: Occupational Safety & Ergonomics Program”, NIOSH, 7/1/12-6/30/17, $710,035 (Kaber & Nam).
Pending Grants:

- “REU-Supplement: Research Experiences to Collaborative Haptic Interfaces (RECHI)”, NSF REESE, 1/1/13-5/31/13, $11,920 (Nam).
- “Assistive Technology Design for Occupational Disease Prevention and Non-occupational Disabilities”, NSF GARDE, 1/1/13-12/31/15, $390,792 (Kaber & Gross; submitted 9/15/12).
- “Making Science Concepts Visible Through Collaborative Use of Haptics”, NSF DRK-12, 8/15/2013-8/14/2016, $500,000 (Nam & Emig; submitted 12/6/12).
- “Feasibility and Practicality of Cooperative Brain-Computer Interfaces (C-BCIs) for Communication and Control”, NSF HCC, 8/15/2013-8/14/2016, $500,000 (Nam & Wu; submitted by 12/17/12).
Research Thrust (1):

- Driver behavior:
  - Impact of distraction (cell phone, nav aid) on driver situation awareness (SA) and performance.
  - Role of cognitive abilities (visual attention, working memory) in driver SA and behavior under hazards.
  - Effects of age and stress disposition on driver behavior and gaze patterns.
  - Influence of motivational factors (incentives) and environment characteristics on driver perceived safety margins.
  - Influence of highway signage design on driver attention and performance.

(Projects have yielded: 2 PhD dissertations; 2 masters theses.)

- Some journal and proceeding publications (chronologically):
Research Thrust (2):

- Human-robot Interaction:
  - Multi-modal interface design for mobile robots.
  - Modeling human behavior in remote robot control.
  - Assessing effects of service robot interface design features on human (emotional) responses.
  - Designing robot speech etiquette.
  - Methods for measuring human emotional responses in service robot interaction.

(Projects have yielded: 1 PhD dissertation; 1 masters thesis.)

- Journal, book and proceeding publications:
- Lab Mission
  - Develop new knowledge in ergonomics and human performance.
  - Develop effective cognitive and physical work technologies.
  - Improve quality of life.

Research Areas

- Overview

This website was recently revised to provide up-to-date information on the mission of the Ergonomics Lab, specific research directions and coursework supported by Lab faculty. The "Lab Tour" page presents images and descriptions of the various equipment resources as part of the Lab. You will also find pictures of our current facilities in the Department of Industrial & Systems Engineering at NC State. The "People" page identifies all the faculty, students and alumni responsible for the research generated by the Lab. If you have questions regarding specific projects or publications, contact information is provided for most persons. The "Research" page provides information on all current externally and internally supported projects as well as completed funded projects. Links are provided for publications resulting from the projects. The "Publications" page presents a comprehensive listing of journal articles and refereed conference proceedings papers published by the Lab since the early 1990s. PDF files of many of these papers are available through the site. The "Courses" page lists all the coursework that is currently offered by faculty working through the Ergonomics Lab. The major areas of coursework include biomechanics, human factors and safety. The page also provides information on prerequisites and course content.

- News

- Recent Student Publications

- Equipment

- Links
Questions? Please contact…

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☐ ISE Graduate Program:
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  ▪ Mrs. Cecilia Chen – cchen2@ncsu.edu

☐ Ergonomics Area and NIOSH Training Program:
  ▪ Dr. David Kaber – dbkaber@ncsu.edu
  ▪ Dr. Chang-Soo Nam – csnam@ncsu.edu