Occupational Safety and Health Training Project

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Project Period 7/01/2016 to 6/30/2021

Final Progress Report

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List of Abbreviations

AIHA	American Industrial Hygiene Association
ASB	American Society of Biomechanics
ASSE	American Society of Safety Engineers
CIH	Certified Industrial Hygienist
CPE	Certified Professional Ergonomist
CSP	Certified Safety Professional
EHS	Environmental Health Sciences
IIE	Institute of Industrial Engineers
ISE	Industrial and Systems Engineering (program)
HFES	Human Factors and Ergonomics Society
ME	Mechanical Engineering
MPH	Master of Public Health
MS	Master of Science
Ohio BWC	Ohio Bureau of Workers Compensation
OSU	Ohio State University
OSH	Occupational Safety and Health
OSUMC	Ohio State University Medical Center
PE	Professional Engineer

Abstract

Our Occupational Safety and Health Training program is designed to satisfy the Master of Science degree program requirements of the Graduate Program of Ohio State University's Integrated Systems Engineering Department, while meeting the needs of engineers and others who wish to work, do research, or pursue further education in occupational safety and ergonomics. The program includes required courses in occupational biomechanics, cognitive engineering, occupational health, industrial accident prevention and control, human error and systems failure, statistics and experimental design, a research practicum, an applied practicum in safety and ergonomics, and choice in electives, including courses in epidemiology, safety in construction and civil engineering, risk assessment, design, and reliability.

During the five year period from July 2016 through June 2021, seven students were supported by the training grant and five of them graduated (along with two that were supported in a prior period, but graduated in this period). Two trainees are in progress. Seven more students who were not supported by the training grant also pursued the same course of study and graduated during the period. The program has an excellent track record of attracting people from groups that are traditionally underrepresented in occupational safety, including women, individuals from ethnic minorities, and individuals with learning disabilities. The program has a good track record of placement of graduates. Students graduating in the 2016-2021 time period are working in the occupational health and safety field. Examples include one graduate who is working as a Human Systems Engineer (Sonalysts, working on simulators to aid surgeons treating injured soldiers), a Program Assistant (VA Medical Center, Indianapolis), and a Sr. User Experience Researcher (Newell, product safety).

The program's impact on workers comes not only through the work of our graduates, but through the safety practicum that each student performs, and indirectly or longer term through the students' thesis research or culminating project. Safety practicums this period engaged students in performing ergonomic job analyses (Rockwell Automation, Milwaukee, WI), developing an ergonomics risk assessment checklist for craft work and performing anthropometric assessments to provide data for redesign of manipulator handles (Idaho National Labs, Idaho Falls, ID), assessing jobs to identify return to work challenges and opportunities (Lowe's, Columbus, OH), and designing a new hand tool for a new assembly operation (Tesla, Reno, NV).

The NIOSH Training Project Grant has allowed us to expand the number of students we have been able to train, to expand our programmatic offering beyond human factors and ergonomics, and to offer a well-rounded, well-conceived program in safety and ergonomics that exposes students to faculty from several departments and colleges at OSU, and numerous expert practitioners in and outside of the Central Ohio area. It has also afforded us the means to support the students' annual attendance at a professional conference (e.g. the Annual Meeting of the Human Factors and Ergonomics Society).

The students have also been involved in dissemination of research, through contributions to conference presentations and writing papers for publication in peer-reviewed journals. Conference presentations included Annual Meetings of the Human Factors and Ergonomics Society (Lavender et al., 2019b; Ngo et al., 2016; Palmer et al., 2017) and the IISE 2020 Annual Conference & Expo (virtual). Journal articles appeared in *Applied Ergonomics* (Amini Pay et al., 2021; Keester and Sommerich, 2017; Lavender et al., 2020). Another manuscript has been accepted for publication in *Work*.

Significant (Key) Findings

The primary outcomes of the program are the students who have or are currently participating in the program, the impact the students have had in their internships and safety practicum experiences, as well as the impact the graduates are having in their careers. During the period from 7/01/2016 to 6/30/2021 we graduated five traineeship-supported students, and two others that were supported in a prior period. The program has an excellent track record with respect to attracting people from groups that are traditionally underrepresented in occupational safety, that is women, individuals from racial/ethnic minorities, and individuals with learning disabilities. The program also has a good track record of placement of graduates in OHS-related jobs. Examples include one graduate who is working as a Human Systems Engineer (Sonalysts, working on simulators to aid surgeons treating injured soldiers), a Program Assistant (VA Medical Center, Indianapolis), and a Sr. User Experience Researcher (Newell, product safety).

The safety practicum continues to be a highlight of the program for students. It provides trainees with real work experience and opportunity to apply their new knowledge in safety and ergonomics, an expanded professional network, and enhances their skill set and portfolio.

The program has strengthened our ties to the Environmental Health Sciences program in OSU's School of Public Health, through required and elective courses that are part of our training program. Students have the option of pursuing a dual master's program with that program, through which a student will graduate with an MS in ISE and an MPH in EHS.

The program has also expanded and strengthened our ties with local professionals, who provide the students with internships, safety practicum experiences, facility tours, and generally share their safety expertise with the students. These local professionals come from organizations throughout the Central Ohio area including Battelle Memorial Institute, Kroger, Worthington Industries, Cardinal Health, and the Ohio Bureau of Workers Compensation.

The program has also had some positive synergistic effects with certain lines of research in which the faculty are engaged. For example, during this period Drs. Sommerich and Lavender were involved in a research project to develop a virtual simulation for training home health care workers to perform Job Safety Analyses in the homes of their clients (Lavender et al., 2019a; Polivka et al., 2019). Former trainee Laura Czuba who worked for a large home health care agency at the time, Salo Solutions, Interim HealthCare, was an instrumental partner in assisting us to access health care workers for recruitment purposes and serving as a subject matter expert. Laura continues to assist us, as a subject matter expert, with a new project, related to the first, the goal of which is to develop an app to aid home health care workers in having successful conversations with clients to address factors in the client's home that pose a health or safety risk to the HHW.

Translation of Findings

As described above, the primary outcomes of the program are the students who have or are currently participating in the program, the impact the students have had in their internships and safety practicum experiences, as well as the impact the graduates are having in their careers. Many of our graduates are working as safety professionals, or as engineers who have some responsibilities for worker safety, or as designers who consider safety implications at the earliest phases of a project. Through all of these roles, they impact workplace safety, and through them, this training grant-supported program impacts

workplace safety. As an example, working at Rockwell Automation during an internship, one of our trainees was able to assist the organization with its transition from an older ergonomics risk assessment system to a new system, analyze and make recommendations for changes in some flow racks that were posing elevated injury risk to wokers, and work with front line workers to identify potential solutions for a manual lifting process that exceeded recommended weight limits.

Outcomes/Impact

Our students encompass potential, intermediate, and end outcomes that improve occupational safety and health. On a daily basis, our graduates are impacting OSH in their work settings, most recently including Kohler, Newell, and the VA. Examples of intermediate outcomes include mentoring of students and new employees by our graduates. From our first cohort, Dawn Chandler, a Human Systems Engineer at Dahlgren, is involved in the organization's formal mentoring programs. Bryan Hennessey and Emma Alder, from our second cohort, participate in our occupational safety course (ISE 5640). Bryan joins us via Skype to talk with the students (including our NIOSH trainees) about his career and about how young (new) engineers can impact safety in an organization. Emma returned to OSU as an Indistrial Hygienist a few years ago and has spoken about that topic to the class. This was particularly impactful in Fall 2020, when she spoke to the students about the extensive amount of respirator fit testing she had been conducting for students in clinical programs at OSU, (due to the pandemic). With regards to potential outcomes, we disseminate the results of research, via conference presentations, publications in peer-reviewed journals, and through theses and reports that are accessible on our university's website. As an example, results from a trainees's thesis research which sought to reduce caregiver injury risk when repositioning patients in bed was recently published in *Applied Ergonomics* (Amini Pay et al., 2021).

Scientific Report

Accomplishments

Seven students were supported by the training grant during this period. Seven trainees or former trainees graduated in this period, including two who were supported in a prior period. Students who are currently supported are in their second year and are expected to graduate in 2022. Graduates are either working in safety-related positions or have continued on to doctoral programs. It is early to be receiving applications for next year, so we cannot provide any information about that at this time. We also have some MS students in the program currently who are not funded through the grant; one has a teaching assistantship through our department, one has a teaching assistantship through another department, one has a research assistantship, and one is supported through an Air Froce program.

During this funding cycle papers from research practicums and student thesis research were published in journals or presented at conferences; we also have manuscripts in review or in preparation. These are listed in Publications section at the end of this report.

The program was successful in exposing students to a number of guest speakers, with expertise in various areas of safety, ergonomics/human factors, and related fields. This is in addition to the students' interactions with researchers and practitioners at the HFES Annual Meetings and other events the students attended. A list of researchers and safety professionals whom the students heard presentations from and were able to interact with is provided just below:

- Erica Gingerich, CIH, CSP, Battelle Science and Technology International
- Ryan Moon, CIH, CSP, Battelle Science and Technology International
- Michael R. Ely, MS, CSP, Environmental & Safety Solutions, Inc.
- Robert A. Minor, JD, Vorys, Sater, Seymour and Pease LLP
- Eric Schaub, MD, OSU Wexner Medical Center
- Alex Darragh, CSP, MBA, MS, VP, Environmental Health and Safety, Cardinal Health
- Elizabeth B-N Sanders, PhD, OSU Department of Design
- Scott McNulty, Public Employment Risk Reduction Program (PERRP), Ohio Bureau of Workers Compensation
- Ziho Kang, PhD, Industrial and Systems Engineering, University of Oklahoma
- William C. Elm, Founder, Resilient Cognitive Solutions
- Sharon Norris, MD, Chief Physician of Occupational Medicine, The Boeing Company
- Chris Brill, PhD, AFRL, Wright-Patterson AFB
- Erik van der Lely, MS, pilot, visiting lecturer, Lund University
- Shawn Pruchnicki, pilot and aviation accident investigator, The Ohio State University
- Asimina Kiourti, PhD, wearables and implantables expert, The Ohio State University
- Chris Reid, PhD, HF/E as a career path, The Boeing Company

We are proud of our retention record, which includes retaining students through the current pandemic. This was a difficult time for our trainees. Each trainee was impacted in differently, but all of them were challenged in ways that far exceeded the normal challenges of graduate school. We were able to retain all of our trainees (and graduate one of them) in the midst of this very difficult time.

During this period, the faculty in the ISE department who participate in the training grant program also advised and graduated seven other MS students who pursued the same program as the training grant-supported students (though without the safety practicum, which is unique to the training grant-supported students). Training grant-supported students benefit from interacting in courses as well as outside of courses with these students, several of whom were international students, as well as with our PhD level students, the undergraduate students who work in our labs, and the cognitive engineering graduate students in the ISE department.

Continuous Improvement
Through feedback and suggestions from current and former students, advisory board members, and guest speakers, improvements are regularly introduced into the program. In particular, the Accident Prevention course is continuously updated in part because of the involvement of Advisory Board members and other professionals who participate through guest lectures or through advice provide to the program director regarding content, as well as input from students as to what they would like to learn through the course.

Life-Long Learning, Service, and Professional Networking
Our students are involved in OSU's student chapter of the Human Factors and Ergonomics Society. In 2017, 2018, and 2019 the chapter was awarded as an "Outstanding Student Chapter – Bronze" level status, a recognition of the number, variety, and quality of activities in which the chapter engaged during the year. Former trainee Eric Weston was recognized at a 'Student Member with Honors Award' in 2019.

In 2020. one former trainee (Eric Weston) and one current trainee (Evan Poska) participated in the American Registry for Diagnostic Medical Sonography® (ARDMS®) Work-Related Musculoskeletal Disorders (WRMSD) Grand Challenge. Both of their teams ideated solutions to the problem of high prevalence of WRMSDs in sonographers. Both teams' solutions were recgonized for their creativity and potential.

Our students are also encouraged to attend meetings of local chapters of AIHA and ASSE, as well as local, annual safety-related conferences: The All-Ohio Safety Congress, sponsored by the Ohio BWC, and the OSU-OSHA Safety Day.

Based on the evidence (our graduates) we believe that we offer a program that prepares our trainees to qualify for and be successful in safety-related careers in a variety of types of industries.

Publications and Presentations Involving NIOSH TPG-Supported Trainees
(NIOSH-supported trainees' names are in bold font; trainees supported in this period are underlined)

Amini Pay, N., Sommerich, C.M., Lavender, S.A., 2021. Assessment of alternative methods for informal caregivers to perform patient repositioning tasks. Applied Ergonomics 93.

Keester, D.L., Sommerich, C.M., 2017. Investigation of musculoskeletal discomfort, work postures, and muscle activation among practicing tattoo artists. Appl Ergon 58, 137-143.

Lavender, S.A., Polivka, B.J., Darragh, A.R., Sommerich, C.M., Stredney, D.L., Wills, C.E., 2019a. Evaluating Home Healthcare Workers' Safety Hazard Detection Ability Using Virtual Simulation. Home Healthc Now 37, 265-272.

Lavender, S.A., Sommerich, C.M., Bigelow, S., **Weston**, E.B., **Seagren**, K., **Amini Pay**, N., **Sillars**, D., Ramachandran, V., Sun, C., Xu, Y., Marras, W.S., 2019b. Lifting Heavy Patients in their Homes: A biomechanical study of equipment that can be used by EMS providers. Human Factors and Ergonomics Society 2019 Annual Meeting, 984-986.

Lavender, S.A., Sommerich, C.M., Bigelow, S., **Weston**, E.B., **Seagren**, K., **Amini Pay**, N., **Sillars**, D., Ramachandran, V., Sun, C., Xu, Y., Marras, W.S., 2020. A biomechanical evaluation of potential ergonomic solutions for use by firefighter and EMS providers when lifting heavy patients in their homes. Appl Ergon 82, 102910.

Ngo, S.P., Sommerich, C.M., Luscher, A., 2016. Digital Human Modeling of Obese & Aging Workers in Automotive Manufacturing. 2016 International Meeting of the Human Factors and Ergonomics Society, 1041-1045.

Palmer, D., Sommerich, C.M., Darragh, A., 2017. Patient Care and Electronic Medical Record Entry Demands on Physical Therapists. Proceedings of the Human Factors and Ergonomics Society 2017 Annual Meeting, 1351-1355.

Polivka, B.J., Anderson, S., Lavender, S.A., Sommerich, C.M., Stredney, D.L., Wills, C.E., Darragh, A.R., 2019. Efficacy and Usability of a Virtual Simulation Training System for Health and Safety Hazards Encountered by Healthcare Workers. Games Health J 8, 121-128.

Sommerich, CM, Kutney, J, **Belegrin**, A, Krishnamurthy, A. Assessing Sonographers' Workload, presented at the IISE 2020 Annual Conference & Expo (virtual).