

Information Collection Request for
“Enhancing Mine Workers’ Abilities to Identify Hazards at Sand, Stone, and Gravel Mines”

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Part B

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B. Collections of Information Employing Statistical Methods

1. Respondent Universe and Sampling Method

According to the National Survey of the Mining Population Part I: Employees (NIOSH, 2012), there are approximately 4,639 Stone Mining Operations and 7,199 Sand and Gravel Mining Operations in the United States. A description of the mines where mine workers are employed will be provided (e.g., size, location, mine type, etc.). Because NIOSH cannot control which mines agree to participate in the study, the data collected cannot be considered representative of the entire population of miners working at U.S. coal mines. It can be assumed that the findings of this study are generalizable to other groups of Sand and Stone and Gravel mine workers who work in similar settings.

One group of subjects will be employees from participating Sand and Stone and Gravel mines. Mines will be recruited via stakeholder meetings and previous research contacts. The mines will be recruited with a goal of including mines that vary in the number of employees on the continuum of size. It is expected that the employees of the participating mines will vary along a number of variables including age, gender, and experience. All employees will be given the option of declining individual participation in the study. A second group of subjects will be safety professionals working within the Sand and Stone and Gravel mining industry. Safety professionals will be recruited in a similar way as mine workers and the mines these safety professionals are employed at are expected to be similar to the mines mine workers are employed at. The third group of subjects will be students enrolled in mining engineering programs or occupational safety and health programs at local colleges and universities – for instance the University of Pittsburgh and West Virginia University. Student participants will be recruited through faculty and previous research contacts. .

It is expected that no more than 62 individuals will participate in the full data collection, approximately 30 Sand and Stone and Gravel mine workers – 16 of these mine workers will be considered experienced and 15 will be considered inexperienced, 15 safety professionals, and 16 students. It is typical in studies using eye tracking methodology to have approximately 10-12 participants in a group when a between subjects design is being used (see Reingold et al. (2001) for an example of a study investigating differences in eye movement behavior based on experience level and Castelhana et al. (2009) for an example of a study investigating eye movement behavior during scene perception). Previous eye tracking research will be used to guide sample size for the current research study.

The sampling of participants for all parts of the study will be convenience sampling. Purposive sampling will be used to ensure that the research team gets a broad sample of mine workers and safety professionals from participating mines with a range of mining experience and training related to hazard recognition and risk perception. While there are many job types at surface Stone and Sand and Gravel mines, for mine workers specific job category will not influence sampling. Purposive sampling will also be used to ensure that the research teams gets a broad sample of students who are enrolled in a mining program at a college or university with a range of knowledge of mine site hazards and an understanding of the risk associated with these hazards. Overall, purposive sampling will be used to ensure the research team gets as broad a sample of mine workers, safety professionals and students as possible. Convenience sampling

will occur based on the mines, miners, safety professionals, and students available to participate at the point in time when assessments are conducted.

One laboratory based study will be conducted. This study will use a mixed methods approach because both quantitative and qualitative data will be collected. Specifically, an experimental research strategy will be used. In addition, several data collection instruments will be used. Finally, participants will be asked a series of open-ended research questions. Data collection is expected to last approximately two years. Data will only be collected once with each participating miner; this is not a longitudinal study. The data collected for this study will be both qualitative and quantitative in nature. Descriptive statistics (e.g., variability and mean scores for each item across the participants) and tests for statistical significance of group differences will be performed. Demographic information will be collected to describe the sampled group (through means and ranges). Qualitative data will be coded by researchers based on particular questions asked.

2. Procedures for the Collection of Information

Data will be collected in the 360° virtual environment within the Virtual Immersion and Simulation Laboratory (VISLab), a virtual reality facility at the NIOSH Laboratories at Bruceton, PA. This data collection will utilize experimental research methodologies where aspects of the visual scene – panoramic pictures of various locations at Stone and Sand and Gravel mine sites – will be manipulated. We will specifically manipulate hazards that are present within the panoramic scenes in order to determine whether study participants are able to identify them. Two other aspects of the visual scene that will be manipulated are (1) the distance of hazards from a fixation marker that is used to initiate scene presentation and (2) the height of the hazard within the scene (foreground, mid-ground, far-ground).

The following is a brief description of experimental procedures that will be used during data collection as well as a discussion of the other questionnaire based measures that will be administered to all participants following the completion of the laboratory based data collection.

Procedure:

Pre-Screening

All potential participants will be pre-screened before being invited to take part in the study (**See Appendix D**). During the pre-screen, potential participants will be asked to answer several questions about their visual abilities. The goal of these questions is to eliminate people with visual deficiencies that may negatively impact ability to perform the research task.

Laboratory Study

All participants will experience the same experimental procedure. All data collection will occur within a 360-degree virtual environment. Prior to beginning data collection,

participants will be asked to read and provide verbal consent for participation **(Appendix I)**.

Participants will first be given instructions about the study. They will be told that their goal is to perform a work place inspection of each scene. While doing this, they are to indicate any hazards they identify. Participants will hold an air mouse throughout the study. When a hazard is identified, the participant is to press a button. Eye movements will also be monitored while they are performing the inspection. In order to monitor eye movements, participants will be asked to wear SMI Eye-tracking Glasses. The Eye-tracking Glasses are lightweight and record to a hand held computing device that is approximately the size of a smart phone. After the participant indicates the Eye-tracking Glasses fit comfortably, the recording device will be secured in a carrying case worn comfortably around the participant's waist.

Before beginning the experimental study, participants will be given time to become comfortable wearing the eye-tracking glasses and hand held computing device and also to practice using the air mouse. Once participants indicate they are comfortable, the experimental study will begin. First, participants will perform a calibration of the eye tracking system. To calibrate, the participant will be asked to fixate a marker on the screen in front of them. After the eye-tracking system is calibrated, participants will be presented with two practice scenes. They will be asked to perform a work place inspection on each of the scenes and to indicate any hazards within the scenes. They will also be given the opportunity to ask questions for clarification purposes. Participants will then be presented with 34 panoramic scenes. Presentation of these scenes will be randomized across participants.

After viewing all of the static scenes for hazard recognition, participants will be given a break. After the break, participants will be shown the panoramic scenes a second time. During the second viewing, each panoramic scene will again be presented. All hazards within a scene will be highlighted and participant responses to the hazards will be indicated. Meaning, participants will be told which hazards were accurately identified, what non-hazards were identified, and what hazards were not identified. Errors will be probed with open ended questions to gain insight as to why certain hazards were not identified (See Appendix H). Finally, participants will also be asked to rate the risk level of the hazards within scenes (see Appendix E) and the Accident Probability and Accident Severity (see appendix E).

Finally, participants will be asked to complete a demographic survey (See Appendix C) and a risk propensity and mine specific tolerance measure (See Appendix F and Appendix G). Because of the limited control NIOSH researchers have over who the mine workers, safety professionals, and students are that take part in the study the demographic survey will be used to describe the sample of SSG mine workers, safety professionals, and students taking part in the study. A variety of questions will be included on the demographic survey related to mining experience, positions held throughout the mining career, number of mines participants has been employed at, number of hazard recognition classes the participant has taken part in, etc. The risk tolerance questionnaire will also be administered at this time.

Research Questionnaires: paper and pencil questionnaires will be administered to all participants. These questionnaires provide a quantitative and qualitative means to collect information from participants about their thoughts on the risk associated with hazards, their thoughts on their own tolerance to risk, as well as demographic information that will be used to describe the study sample. Below is a brief description of each questionnaire that will be administered.

- Risk Assessment: Individual perceived risk level, accident severity, and accident probability will be assessed in a method similar to that used by Perlman, Sacks, and Barak (2014). All participants will be asked to assess the overall risk level for each hazard presented in the study. Overall risk level will be assessed using a 5-point scale ranging from 1 (very low) to 5 (very high). It is common practice to multiply accident severity with accident probability in order to obtain an overall risk level (Iannacchione et al., 2008). In an attempt to determine whether participants use severity or probability to guide decisions about risk level, participants will also be asked to assess accident severity and accident probability. Accident severity will be assessed using a 5-point scale ranging from 1 (No injury) to 5 (Fatal) and Accident probability will be assessed using a 5-point scale ranging from 1 (Very unlikely/infrequent) to 5 (Very likely/frequent). See Appendix E for the Risk Assessment Measure.
- Risk Propensity Scale (RPS) was developed to measure the general tendency to take risks (Meertens & Lion, 2008). The RPS includes 9 items. These 9 items are statements related to risk taking and are rated on a 9-point scale ranging from 1 (totally disagree) to 9 (totally agree). One item is rated on a scale from 1 (risk avoider) to 9 (risk seeker). Higher scores indicate higher risk-seeking tendencies. See Appendix F for the full scale.
- Risk Tolerance Workplace Scenarios were developed by Lehmann, Haight, and Michael (2009) in accordance Reyna and Lloyd (2006) and Hunter (2002) where situationally relevant, hypothetical scenarios were presented to participants to determine risk tolerance. Lehmann et al. developed scenarios relevant to mining and asked participants to indicate comfort level – an indicator of potential behavior - with the hypothetical scenarios. The three scenarios differed based on varying levels of personal risk to the participant and are rated using the following: very comfortable, comfortable, uncomfortable, very uncomfortable. Responses are then coded as 1, 2, 3, and 4 respectively and then averaged together for an overall score of risk tolerance. A lower score indicates higher risk tolerance. See Appendix G for the scenarios.
- Demographic Questionnaire was developed by NIOSH researchers to obtain participant information from each mine worker and student who volunteers to take part in the study. The questionnaire includes open-ended questions designed to elicit information related to total work experience, specific jobs performed at a mine site, and the types of training the participants has obtained. See Appendix C.

Qualitative Data Collection:

In order to more fully understand why miners identify or fail to identify hazards, focused questions will be developed to address this concern. By using these focused questions, we will be able to identify perceived differences (and similarities) between the identified and non-identified hazards based on the studied cognitive constructs of attention and risk. Therefore, theory related to visual search and attention (Crundall et al., 2004), risk perception (Slovic et al., 2004), and risk tolerance (Hunter, 2002) will be

used not only to guide question development but also the analysis of the qualitative data. It is anticipated that a small number (no more than 5) of open ended questions will be created to probe errors. OMSHR researchers will also ask follow-up probes related to participant responses. See Appendix H for the list of open ended questions.

3. Methods to Maximize Response Rates and Deal with Nonresponse

It is anticipated that the majority (at least 72%) of individuals who take part in the pre-screening phone call will qualify for the laboratory study. While this response rate is below the OMB expected response rate of 80%, there are possible reasons why response rate may fall below 80%. The majority of the stone, sand and gravel mines are considered small mines. There are typically less than 25 people working at these operations. While we will recruit participants through previous contacts, there are times when a participant who has expressed interest in participating in the study will be unable to do. As an example, there are likely to be three mine workers trained to operate a haul truck at a small mine. The haul truck operator is a position that is critical for production. A participant with this job title may be unable to take part in the study because his skill set is necessary at the mine site. Moreover, because of the nature of the laboratory study, it is necessary to conduct the research at the NIOSH/OMSHR Bruceton Research facility because of the nature of the research study. All data will be collected one-on-one with participants. Efforts will be made to coordinate with participants ahead of time to minimize time spent on site. This means that efforts will be made to not have participants wait to complete any parts of the study while on site. Previous experiences with data collection efforts onsite at the NIOSH/OMSHR Bruceton Research facility with mine workers, safety representatives, and students suggest that we will likely be more successful than the 72% response rate. An example of a recent NIOSH/OMSHR research project that has achieved a 90% response rate is Virtual Reality to Train and Assess Emergency Responders (OMB No. 0920-0975, expires 07/31/2016) which saw between 90 and 95% of the mine workers recruited complete the study.

4. Tests of Procedures or Methods to be Undertaken

A critical aspect of this research is the hazards that will be included in the panoramic scenes. A variety of methods will be used to identify SSG hazards and the associated risk levels. First, the Mine Safety and Health Administration (MSHA) along with the National Stone, Sand and Gravel Association (NSSGA) has compiled training materials to provide meaningful compliance assistance to new operators in the aggregates industry. Among these training materials are guides, procedures, and assessments that can be used to raise awareness for a variety of hazards (see http://www.msha.gov/safetypro_in_a_box/index.asp). These materials will be reviewed and all possible hazards will be noted for this research. Hazards will also be gathered from the most frequently cited standards by MSHA for stone, sand, and gravel mine sites during the past 5 years. An analysis of fatal reports and non-fatal days lost data for those same years will also be analyzed. Finally, Subject Matter Experts knowledgeable in Stone and Sand and Gravel Mining will be consulted.

All other questionnaires used during the study have previously been used in research studies.

5. Individuals Consulted on Statistical Aspects and Individuals Collecting and/or Analyzing Data

The persons who will collect and/or analyze the data are listed below.

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