Improving Safety in the Construction Industry using a High Fidelity Virtual Environment and Psychology

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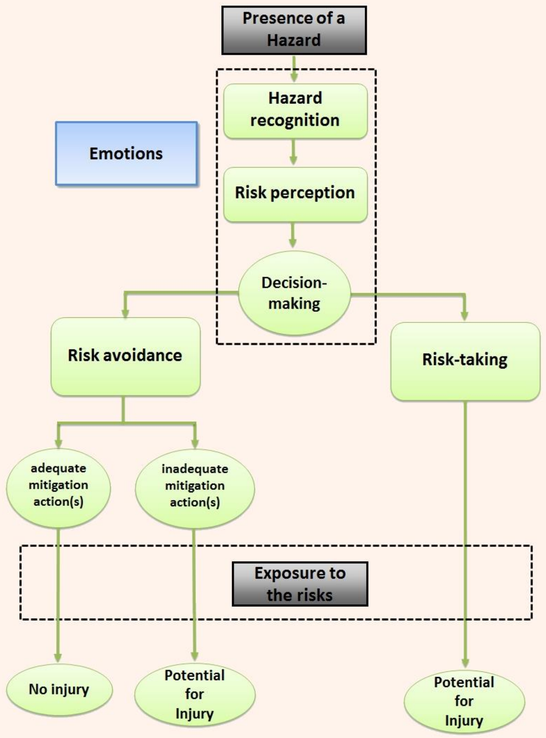
Importance of the study:

Every year, the United States construction sector accounts for more than 1,000 fatal injuries. Such high injury rates partly occur because construction personnel such as workers, engineers, managers and designers are unable to predict, recognize and respond to construction safety hazards, as well as to assess the risks associated with work tasks and work conditions.

Recent research indicate that construction personnel are unable to recognize about 60% of the hazards present on the workplace, and a result, are exposed to unanticipated risks.

Research in psychology has shown that emotions play a very important role in decision-making under risk. Emotions are held to be unconsciously used as a source of information about the riskiness of the environment (risk perception), while also acting directly on cognitive processes (decision-making). This approach to risk-taking has yet to be adopted in the field of construction safety.



Research Objectives:

(1) Develop a high fidelity virtual environment (VE) that is suitable for hazard recognition training in the construction industry.

(2) Improve the learning experience by combining essential concepts from the field of psychology and behavioral sciences (energy based retrieval mnemonics, serious gaming) with the virtual environment.

(3) Compare the efficiency of the virtual environment training with OSHA training in developing hazard recognition skills among construction personnel.

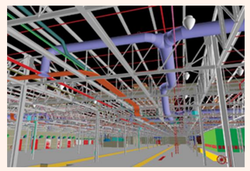
(4) Testing the impact of emotions on risk perception (RP) and risk tolerance (RT) within high risk virtual construction environments

(5) Enhancing the understanding of the general validity of psychological risk-taking theories

(6) Extending psychological risk-taking theories to construction personnel within the context of construction safety.

Methodology:

Phase 1: Development of a high fidelity virtual environment

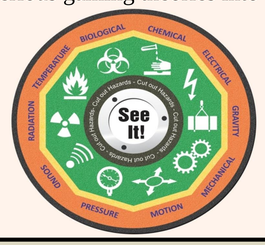


BIM Model

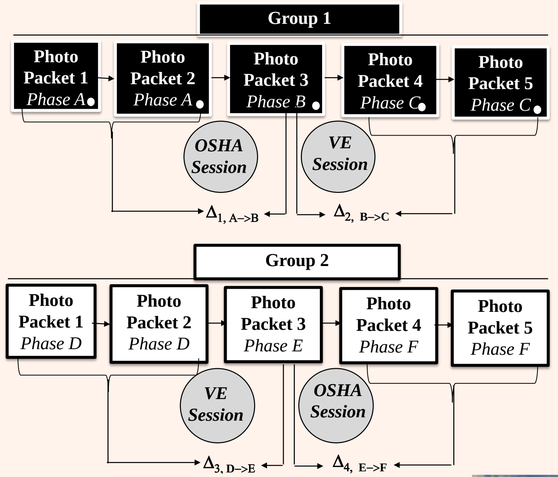
Photograph database

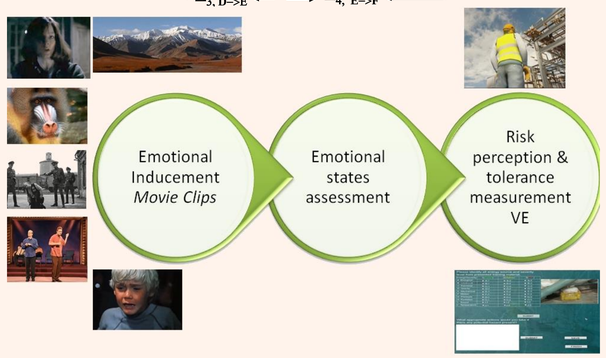
Game engine

Phase 2: Integration of energy based retrieval mnemonics and serious gaming theories into the virtual environment



Phase 3: Testing the virtual environment as a training tool using a **Multiple Baseline Testing** design**.** Measuring the impact of emotions on risk perception and risk tolerance.



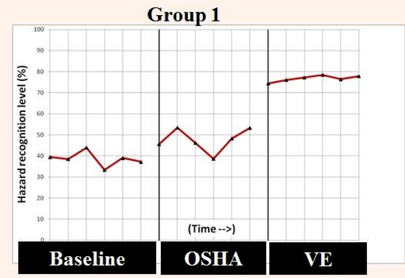


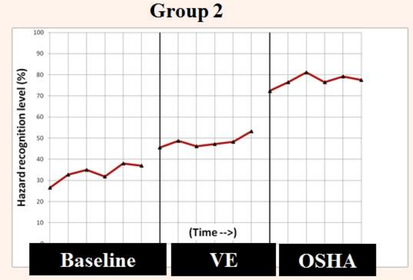
Analysis:

Phase 1: Analysis of the empirical data using a **Multiple Baseline Testing** approach

$$HR = \frac{H_{id}}{H_{total}}$$

Where H_{id} represents the total number of hazards identified by the participant in a given photograph and H_{total} represents the total number of identifiable hazards present in the photograph

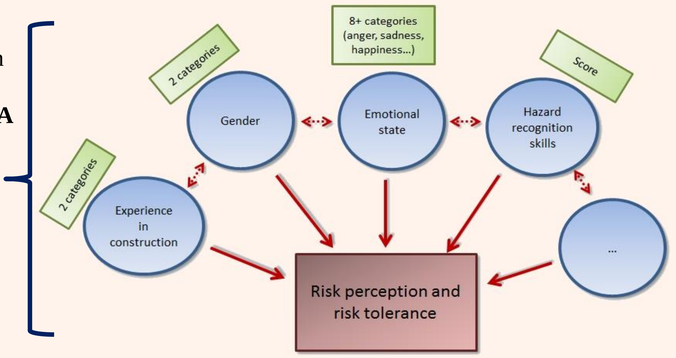




Analysis:

Phase 2: Analysis of the empirical data on emotions using:

- ***n*-way factorial design** such as **ANOVA or MANOVA** (univariate/multivariate analysis of variance),
- **General linear modeling** such as **Multiple regression** analysis.



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