

Medical Training in Virtual Environments

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1) Toward Virtual Stress
Inoculation Training of Prehospital
Healthcare Personnel

Problem and Motivation

- Emergency personnel (e.g., EMR, EMT) find, rescue, and take prehospital care of patients
- Key factor for survival
- Stress impacts performance and causes mental disorders
- Stress inoculation training (SIT) lets trainee practice stress-coping skills in controlled environment
 - Desensitize trainee to similar real-world stimuli
 - Render future task less novel



Phramongkutklao Hospital

3-Phase SIT

1. *Cognitive preparation* – Educate trainee about stress and its effects
2. *Skill acquisition and rehearsal* – Teach stress-coping skills such as relaxation, self-talk, imagery, problem solving, and breathing
3. *Application and practice* – Let trainee practice stress-coping skills in a controlled stressful environment



VR, Storytelling, and Emotional Connection

- VR for immersive and controllable environments that are otherwise too costly, too dangerous, or even impossible to setup
- Storytelling could be used to increase user engagement and elicit strong emotional responses
- Possible utility of emotional connection in inducing stress, e.g., doctors closer to patients found their deaths to be more emotionally powerful medium.com



Toward Virtual Stress Inoculation Training of Prehospital Healthcare Personnel: A Stress-Inducing Environment Design and Investigation of an Emotional Connection Factor

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Experiment



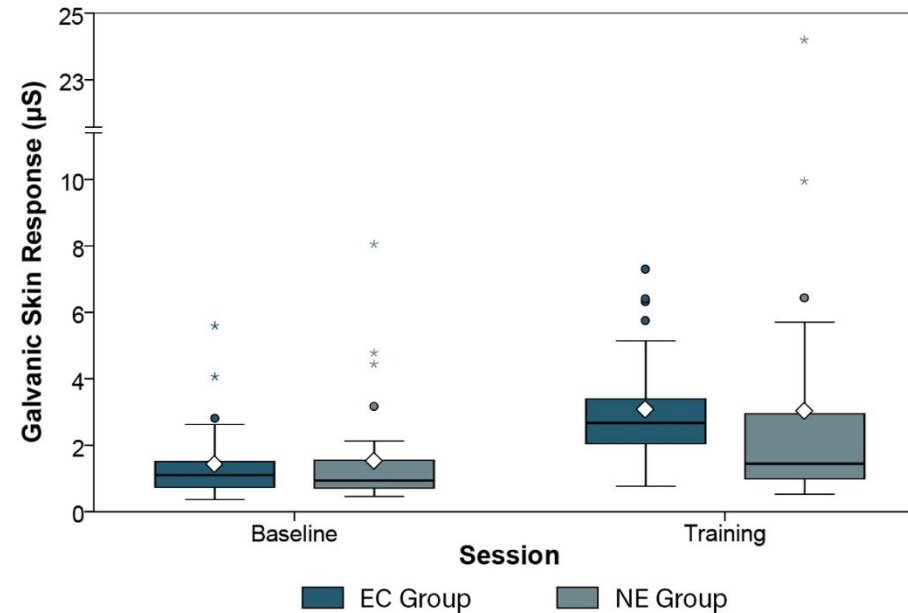
eSense GSR sensor



iOX Oximeter (HR)

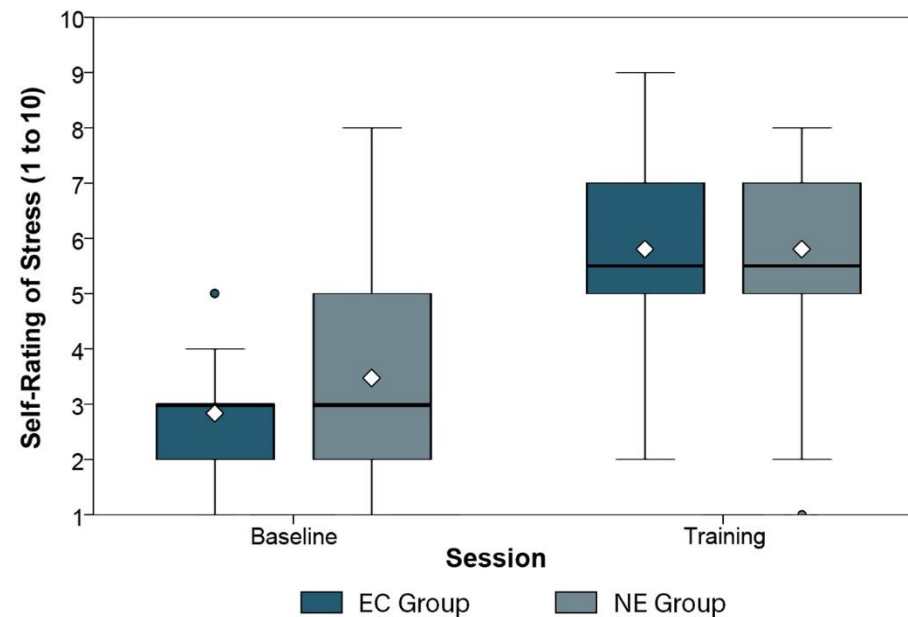
- Stress-inducing and presence qualities, including impact of an emotional connection factor
- Between-subjects design (N = 60): EC and NE groups
- Stress measures: GSR, HR, SR (Self-Rating on 10-point scale)
- See paper for results related to sense of presence and the impact of an emotional connection factor

GSR (Galvanic Skin Response) Results



- In both groups, there was a significant increase in GSR level from baseline to training session
- Percentage change of GSR was significantly higher in EC group (135% vs. 54%)
- HR results consistent with GSR ([see paper for details](#))

SR (Self Rating) Results



- In both groups, there was a significant increase in SR level from baseline to training session
- Percentage change of SR was not significantly different between groups

Discussion: Stress-Inducing Quality



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- Our approach induces stress in subjects, which provides the controlled stressful environment requirement of SIT
- Interview responses reveal main stress-inducing factors:
 - Making a decision on who to save
 - The unexpected explosion
 - Witnessing injuries and blood
 - The death of or injury to the senior EMT
- Other possible factors: Unnatural touch-based navigation, motion sickness, HMD weight, fear of being judged, sensor displacement

Conclusion and Future Work



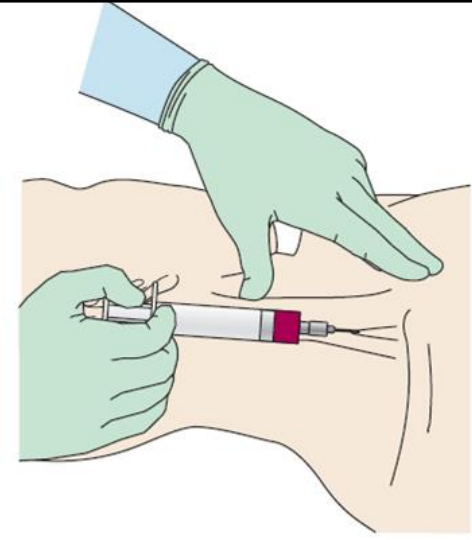
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- Story-driven virtual environment providing the controlled stressful environment requirement of SIT of emergency personnel
- Will investigate integration of the approach into a full 3-phase SIT
- In collaboration with Phramongkutklao Hospital

2) Vascular Access Training VR Simulator

Vascular Access

- Here, refers to the insertion of a needle into a central vein
- Important step in the central venous catheter insertion used to provide medical treatment, e.g.,
 - Quickly deliver large amount of fluid into the body
 - Provide high concentration drugs
 - Hemodynamic monitoring
- Common treatment done several millions times per year in the U.S.



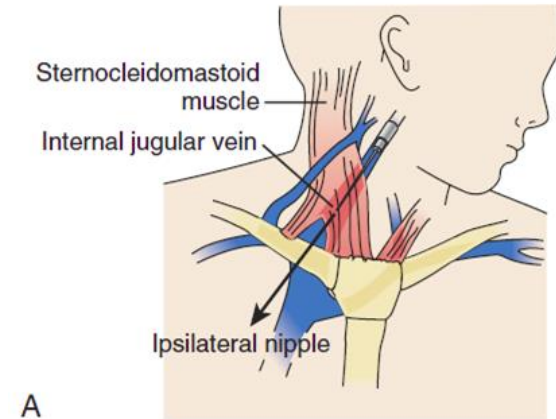
Vascular Access Training



- Proper insertion is important to avoid injury to surrounding tissue
- Practicing on real patient is risky, e.g., mistake may lead to an injury to an artery or another organ
- Practicing on manikin also has limitations:
 - Cost of high-fidelity model
 - Damage to the manikin
 - Lack of adequate feedback for self evaluation

Internal Jugular Access

- VR could be used to address these problems
 - Safe, minimal incremental cost, rich feedback
- Initially, focus on internal jugular (IJ) vein and middle approach
 - IJ is a popular location and has low risk of infection
 - Middle approach enables easier identification of landmarks
 - Enter at the apex of the triangle formed by sternocleidomastoid muscles and clavicle
 - Toward ipsilateral nipple at ~45-60 degrees with the skin
 - No deeper than ~3 cm from the skin



VR Simulator



Haptics:
Skin
Fat
Vessel wall
Bone

Head tracked & stereoscopic 3D visualization

Benefits of Virtual Training

- Produces experiences that are vividly remembered
- Motivation & engagement may be increased with good VR experiences
- Safe training with little or no incremental cost
- Encourages experimentation and learning from mistakes
- New modalities for feedback and guidance not possible in physical world
- Process can be recorded for analysis and review
- Objective assessment of process and outcome
- Free instructors for other tasks
- Increased training time
- Physical distancing





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The Virtual Reality Research Group at the Faculty of ICT, Mahidol University

Thank You!
Any Question?

<http://mucc.mahidol.ac.th/~mores.pra/vrlab>