Can computer games aid in diagnosing and treating combat-related PTSD?

The "Games for Health" Project

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Agenda

- Background and Motivation
- Design
- Demonstration
- Game Functionality
- Study
- Results and Future Work

Project Mission

Develop a game based tool, using affective computing*, that addresses combat-induced PTSD

*Affective Computing: the study and development of systems and devices that can recognize, interpret, process, and simulate human affects.

Why Games?

Freedom to create almost any possible (or impossible) environment to **interact** with and **experience** within

Structure experience and behavior through rules and affordances


MODE

He made it through, yes?

Where is your entry permit?

Please, I beg you.

They would not give me permit. I have no choice.

I will be killed if I return t
Antegria.

DENIED

APPROVED

ALIGN VISA BENEATH STAMP

ENTRY VISA

Martin, Wilma

DOB. 1949.09.14
SEX F
ISS. Glorian
EXP. 1983.05.23

ANTEGRIA

QPMAQ-3JH1H

62 kg

09

Multi-Disciplinary Team

- Researchers
- Games developers
- Psychiatrists
- Veterans

Target Group

- Veterans
- Clinical PTSD
- Afghanistan experience
- Foot patrol
- 20-30 years of age

Design Criteria

- Normal therapeutic practice
- Minimize therapist intervention
- Low technical complexity
- Useful for a wide range of patients

Design Inspirations

- Stress Inoculation Training
- Exposure Therapy
- Virtual Reality Therapy
  - Virtual Iraq
  - Virtual Afghanistan


Virtual Iraq: Exposure Therapy to Treat PTSD

PTSD is Personal

- Trauma
- Symptoms
- Triggers
- Response patterns

- Configurable game
- Stress inoculation
- Exposure therapy
- Stress detection

PTSD Physiological Characteristics

- Heightened
  - skin conductance activity
  - startle response
  - resting heart rate
- Slower
  - skin conductance habituation

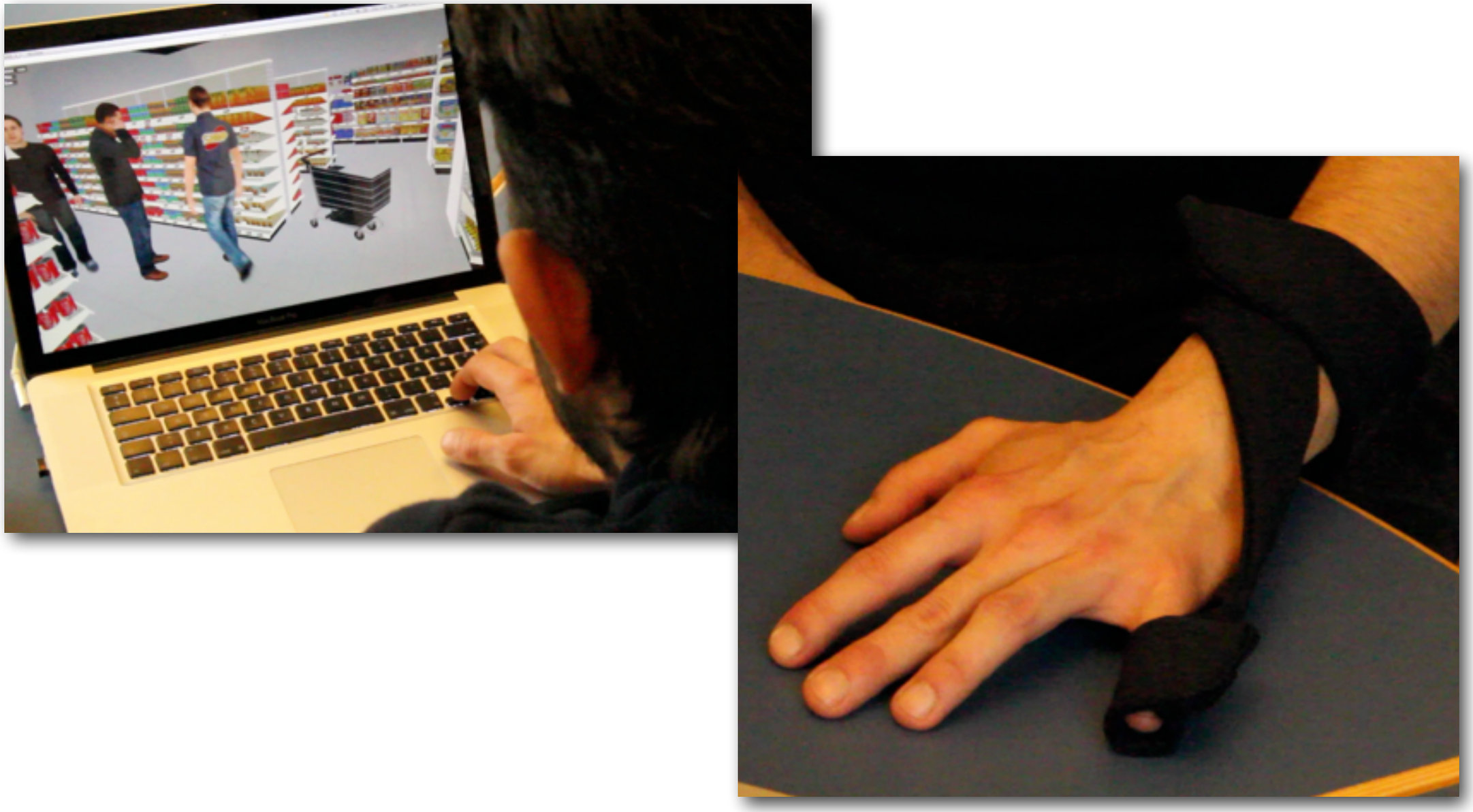
The Game we Developed:

StartleMart

Game based diagnostic and treatment tool that records physiological indicators of stress

Demonstration

How is StartleMart used?



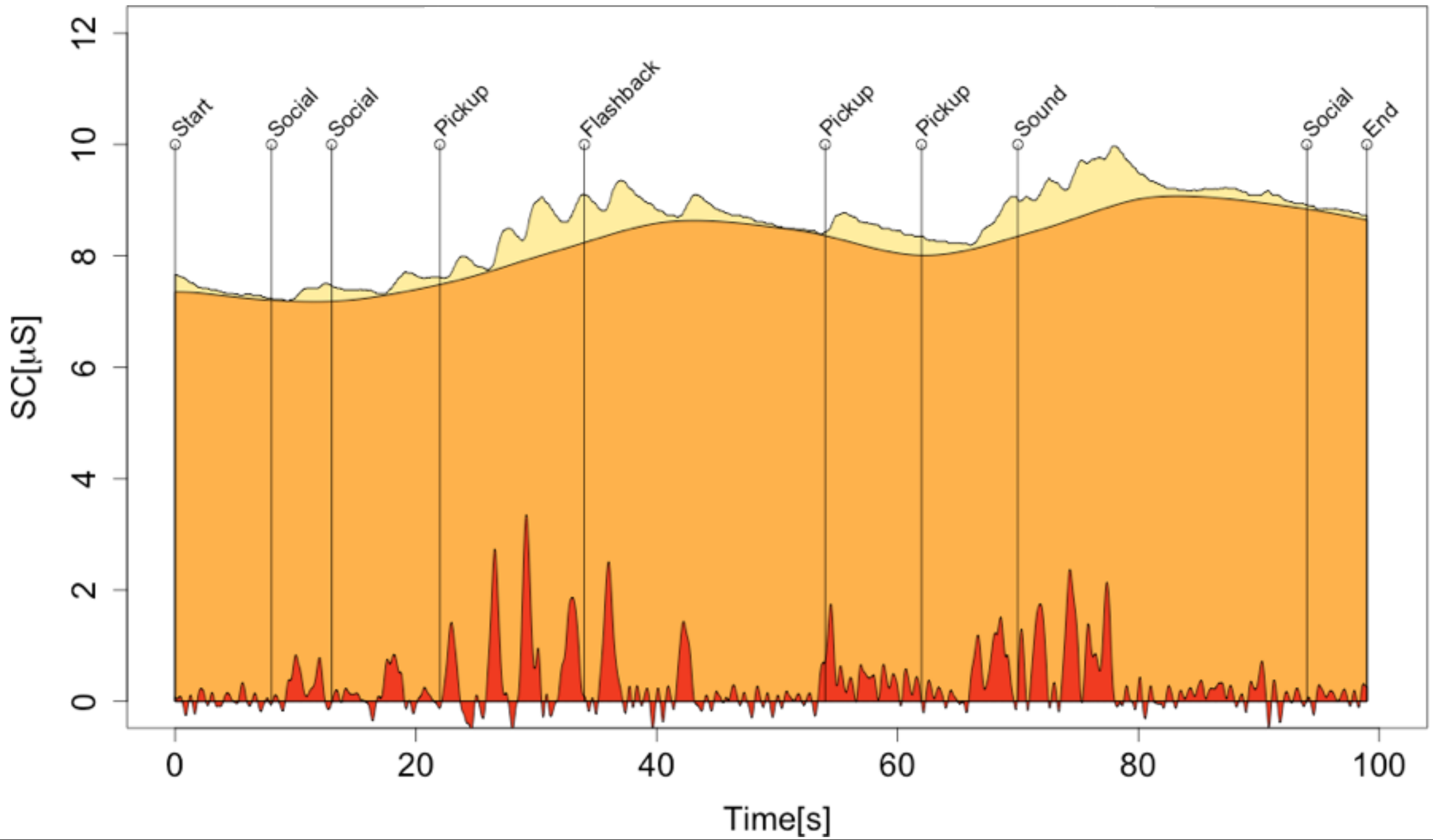
How does StartleMart capture stress?

Empatica E2 sensor

IOM Sensor

How does

StartleMart capture stress?



Study

- Purpose: Relevance of StartleMart
- 14 male PTSD patients
- Non-psychotic
- 2 testing days, 3 sessions each day
- 14 days apart
- Tests conducted at psychiatric clinic
- Administered by psychologist

Experimental Configuration

- Minimal patient/experimenter interaction
- Large display
- Headphones
- Maximal exposure
- Minimal distraction

Protocol

First day → 2-3 weeks → Second day

Clinical interview → Introduction equipment → Rest and baseline → Gameplay → Self-report, rest, baseline → Gameplay → Self-report, rest, baseline → Gameplay → Self-report → De-briefing

Key Features

- Profile
  - PCL-M score
  - # deployments
  - Days since deployment
  - Session stressfulness (SUDS)
- Skin Conductance
  - 16 features
  - Mean, max, min and differences
  - Global and local variation

Session Analysis

- SC normalization: individual, same day
- Feature extraction from SC signal
- Self-reports of stress
- Rank correlations
  - Signal/profile
- Pair-wise correlations
  - Signal/self-reports

Main Findings

SC Feature	Relation	PTSD Profile feature	Interpretation	ρ
SC_{max}	↑	PCL	Hyper-arousal	0.29
SC_{last}	↑	PCL	Hyper-arousal	0.35
$SC_{last-init}$	↑	PCL	Hyper-arousal	0.31
$\lvert SC_{last-init} \rvert$	↑	PCL	Hyper-arousal	0.32
$SC_{\lvert \delta 1 \rvert}$	↑	PCL	Hyper-arousal	0.29
$SC_{\lvert \delta 2 \rvert}$	↑	PCL	Hyper-arousal	0.28
$SC_{\lvert \delta \delta \rvert}$	↑	PCL	Slow habituation?	0.28

SC Feature	Relation	PTSD Profile feature	Interpretation	ρ
SC_{min}	↓	N_{dep}	Unclear?	-0.31
SC_{last}	↓	N_{day}	Recovery	-0.30
$\lvert SC_{last-init} \rvert$	↓	N_{day}	Recovery	-0.35

SC Feature	Relation	PTSD Profile feature	Interpretation	c(z)
$SC_{max-min}$	↓	Preferences, adjacent	Hyper-arousal, slow habituation	-0.25
$SC_{max-min}$	↓	Preferences, day	Hyper-arousal, slow habituation	-0.19
SC_{init}	↑	Preferences, day	Hyper-arousal	0.25

Results

Significant rank correlations between extracted features and profile features

Ongoing Work

- Event level analysis
- Prediction of PCL and self-reports
  - Preliminary results
- Comparison to non-PTSD veterans
- Treatment efficacy study

Preliminary Results

- PCL prediction
  - Multilayer Perceptron (5-7-1) regression
  - 0.91 correlation
  - RSME 2.1 points on PCL
- Most stressful event prediction
  - Multilayer Perceptron (11-7-2) classification
  - 85 % of reports correctly classified

Can computer games aid in diagnosing and treating combat-related PTSD?

- Patients responded to simulated everyday environments - found experience relevant
- Significant relations between physiological responses and symptom severity
- Using machine learning, we can predict responses and PCL score (for our sample)
- Possible usefulness as diagnostic support?
- No knowledge of treatment efficacy from our study
- Related approaches (VR-therapy) have seen positive treatment effects for some groups of patients

Thank you!

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