VR Exposure and NB Feedback

Coping with Traumatic Events

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Handling Traumatic Events

• In diverse domains—such as defense, police and first aid—professionals may encounter traumatic events during their work.
• The practices of prevention (early detection) and treatment of trauma-related disorders, like Post Traumatic Stress Disorder (PTSD) show two problems:
  • Professionals find it hard to imagine, reminisce and discuss such events.
  • Clinicians and trainers have to address the many differences in how professionals cope with traumatic events, show specific symptoms and handle confrontations.
Support Prevention and Treatment

• Combining Virtual Reality (VR) and bio-neuro feedback that
  • Improve the activation of the traumatic memory or mental representation with VR exposure and support systematic desensitization with bio-neuro feedback.
  • Measure individual responses to this activation and support personalized adaptation of the exposure.
Stress Responses

Pre-frontal structures

Mid brain

Autonomic Nerv. system

Endocrine system

Sympathetic

Parasymp.

HPA-axis

Heart Rate

Heart Rate Variability

Cortisol

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Cortisol
VR Exposure and Stress Responses

Stress Exposure via VR
- Virtual Battle Space (VBS2) game engine to evoke visual and auditory experiences.
- Suit to evoke tactile experiences.
- Feedback to evoke negative socio-cognitive experiences.

Stress Responses
- Decrease in parasympathetic cardiac control (e.g., heart rate variability)
- Sympathetic overactivity (e.g., heart rate)
- Production of glucocorticosteroids by the HPA-axis (e.g., cortisol).
- Prefrontal asymmetry in EEG alpha power (8-13 Hz):
  - more right activity (“withdrawal”)
  - more left activity (“approach”)
EEG
Police Patrol Experiment (1)

Baseline

1st visit “stress city”

Revisit “stress city”

Revisit “non-stress city”

1st visit “non-stress city”
Police Patrol Experiment

• The participant drives in a car and has to inspect the environment for persons who might show criminal behavior and for objects that might contain explosives.
• First, they patrol in city A that shows an unsafe scene, in which different stressors will appear (from negative social feedback to explosions with corresponding sounds and triggers of the tactile suit).
• After a rest and some measurements, they have to patrol in city B that shows a safe scene.
• With rest periods in between, they have to patrol again in city A and, subsequently, city B, both show a safe scene.
First Results (1) 2\textsuperscript{nd} visit: mid-frontal asymmetry was higher when the participants patrolled in the same city that included stressors the 1\textsuperscript{st} time.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{chart.png}
\caption{\textbf{F3/F4} \hspace{1cm} $p = .031$}
\end{figure}
First Results (2)

• Cortisol levels increased after the appearance of the stressors, and decreased during recovery.

• Higher subjectively reported stress was accompanied by higher absolute parietal asymmetry (P3/P4; related to “arousal”).

• Higher Behavioral-Inhibition-System (BIS) scores (related to “avoidance”) were accompanied by lower lateral frontal asymmetry (F7/F8).

• Nose temperature decreased after the explosion.
Conclusions and Discussion

• Via VR exposure, pre-frontal and endocrine stress responses can be recorded
  • *data of autonomic nervous system have to be analyzed yet (i.e., heart rate)*
• Particularly, the re-appearance of the environment showed the asymmetry effects of frontal activity (i.e., when memory is involved)
• EEG may help to distinguish specific response patterns to stressors.

• In general: combining VR exposure with Neuro-Bio feedback seems to be a promising approach.