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VR environment specification

Behavioural and psychophysiological markers of response to social and non-social stressors in schizophrenia - a virtual reality study

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1. Aim of the project and general outline of the VR environment

The virtual environment described below will be used in research regarding response to social and non-social stressors in general and clinical populations. The *Metro* procedure described below will allow to simulate exposure to social and non-social stressors of different intensity. Response to stressors will be measured of two levels – behavioural (declarative level of distress) and psychophysiological (electrodermal activity and heart rate variability).

The study will consist of two parts: Experiment 1 (E1) and Experiment 2 (E2). In E1 volunteers from general population will participate in order to determine the optimal intensity of stressors for E2. In E2 two groups of participants will be recruited – patients with schizophrenia and healthy controls. The aim of E2 is to compare responses to different types and intensity of stressors in healthy population and patients with schizophrenia.

In both experiments subject's task will be to travel through 5 stations and disembark at the sixth stop. During the journey baseline condition and four experimental conditions will be presented. Each of the conditions will last about 5 minutes. Duration of the entire procedure should not exceed 40 minutes. Interior of the metro wagon should be modelled on the Warsaw Subway. Experiment will be conducted in Polish.

2. Conditions

The background for each condition will be an empty wagon in which general outline of 3D models of passengers
(2-3 models) will be visible in the distance (or in the next wagon). These models will be present in each of the four experimental conditions and the control condition.

2.1. The baseline condition

The control condition is always presented as the first one.
Video: the subject is in the wagon and sits down in a designated place. There are no other passengers, no changes in the intensity of lightening take place.

Audio: in the background you can hear low-intensity sound of the moving wagon and other typical sounds for the subway (sound signal before closing the door, sound of closing and opening the door to the wagon).

2.2. Experimental conditions

The four experimental conditions described in the table below will be presented in pseudo-randomised order, so that their combination is counterbalanced between subjects.

	Experimental condition			
	I	**II**	**III**	**IV**
Type of stimuli	social (agents)		non-social (noise and lights)	
Intensity	High	low	High	low
No. of passengers*	15	5	-	-
Face expression	Threatening face expression, passengers frequently (5-10 times) look at the subject	Neutral face expression, passengers do not look at the subject	-	-
Lighting*	Constant, moderate light intensity	Constant, moderate light intensity	Frequent and intense changes in light intensity (resembling power outage)	Sporadic and delicate changes in light intensity (delicate flickering)
Audio*	In the background: hum of the moving wagon and low-intensity sounds typical for subway(sound signal before closing the door, sound of closing and opening the door to the wagon)	In the background: hum of the moving wagon and low-intensity sounds typical for subway(sound signal before closing the door, sound of closing and opening the door to the wagon)	In the background: high-intensity noise of the moving wagon and loud sounds typical for subway(sound signal before closing the door, sound of closing and opening the door to the wagon). In the foreground: loud grinding of the wheels against rails and metallic creaking of the wagon.	In the background: low-intensity noise of the moving wagon and low-intensity sounds typical for subway(sound signal before closing the door, sound of closing and opening the door to the wagon). In the foreground: low-intensity grinding of the wheels against rails and metallic creaking of the wagon.

* the exact number of agents, frequency of glances towards the subject, the frequency of lighting changes and the intensity of sounds will be determined during pilot study phase.

Ad. Condition I:
- Condition I should be created in several alternative versions (minimum 8)
- agents' gazes towards the examined person should be randomly distributed over time
- entering the wagon, agents have a neutral facial expression, it only changes when they look towards the participant
- agents do not communicate with each other
- after entering the wagon, about ⅓ of the agents sit down, and ⅔ of them are standing
- looks start randomly from the moment you enter the wagon.

Goal: the highest level of naturalness in the temporal arrangement of movements (avoiding the impression of "robotic" movements and their unnatural repetitions).

2.3. Timeline

The baseline condition is always presented first. Other conditions follow in a pseudo-random order. In each of the conditions, after 3 minutes of its duration, a virtual tablet appears on which the examined person assesses their current state.

3. 3D models

3.1. Subject

The participant has a first person perspective. It is not possible for them to move around the wagon and they remain seated throughout the procedure. A brief embodiment procedure combined with a tutorial of using the virtual tablet will be carried out before to the beginning of the experiment.

3.2. 3D models of passengers

Co-passengers will be both men and women, with the same number of characters of each sex. At least 5 neutral and 15 threatening 3D high fidelity models of co-passengers should be created.
The agents in condition I and II cannot be repeated, but models in both conditions should have similar physical characteristics (similar clothes, colours, age, equal number of models of each sex). Due to the structure of the population in Poland, Caucasian models should dominate. Models' movement should be based on motion capture technology.

3.3. Subway model

The model of wagon's interior, as well as each station should be based on a scan of Warsaw Subway.

4. **Hardware and variable measures**

The VR environment will be presented using the HTC Vive Pro kit and a PC with Windows OS. The environment should be programmed in the Unity or Unreal.

During the examination, following data will be recorded:

a) psychophysiological signals using Biopac Systems set
- skin galvanic reaction (EDR)
- heart rate (HR)

b) behavioral response to stressors

- subject’s explicit response to questions presented of the virtual tablet (e.g. on a scale from 0 to 100, where 0 - "not stressed at all"; 100 - " very stressed. "). Subject will respond on the tablet by navigating HTC Vive pad.

c) markers (via LPT port) corresponding to:
- beginning of the task
- the type of condition
- the start of each condition
- the end of each condition
- agents looking towards the examined person (condition I)
- flashes of light (condition III and IV)
- noise (condition III and IV)
- the moment of presentation of the virtual tablet
- the moment of answering on the virtual tablet
- end of task

d) eyetracker data from HTC Vive Pro googles

Respondents' responses, markers and psychophysiological signals as well as eyetracker signals will be recorded on a Windows desktop computer.

5. Application – additional features

The application should allow to modify of the order and number of presented test conditions. Also, it should be possible to customize contents displayed on the tablet.

6. Project implementation

The VR application should be ready for use in research by May 2020. The preparation should also include testing time and a minimum of two rounds of adjustments.