Event-related Potentials (ERP) during Simulated Driving

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Experimental paradigm

Fifteen healthy individuals (all male and right-handed, age 27.1 ± 1.7 years) participated in this study. All participants had a valid driver's license and had driven three years without an accident. All had normal or corrected-to-normal vision. None of the participants had a previous history of psychiatric, neurological, or other diseases that might otherwise affect the experimental results. The experimental procedures were explained to each participant. Written informed consent was obtained from all participants before the experiment. The participants received a monetary reimbursement for their participation after the completion of the experiments. The participants were seated in a driving simulator cockpit (made by R.CRAFT in Korea) with fastened seat belts (the experimental apparatus is shown in Figure 1).

Figure 1. Experimental apparatus and environment.

The participants' task was to drive a virtual vehicle using the accelerator and brake pedals and the steering wheel; the virtual vehicle was equipped with a virtual automatic transmission. They were instructed to drive freely without getting into an accident, and to perform immediate braking to avoid crashes if necessary. The maximum speed of the participant's vehicle was 120 km/h. Thus, the participant could pass autonomous vehicles. We defined three kinds of braking situations based on braking intensity. First, if an emergency situation occurred, the participants were instructed to depress the brake pedal sharply. We defined this situation as sharp braking. Second, when the participant performed spontaneous braking to decrease the vehicle's speed, the vehicle decelerated 'softly' (i.e., gradually). This situation was defined as soft braking. Finally, in many situations, the participants did not need to decrease the speed of their vehicle. Besides normal driving situations, this was also true if a lead vehicle a long distance away braked abruptly, or if a close-by vehicle on the neighboring lane braked abruptly. We defined this situation as no braking. For all of the stimuli, the inter-stimulus interval was between 4 and 18 s, and drawn randomly from a uniform distribution (see Figure 2).

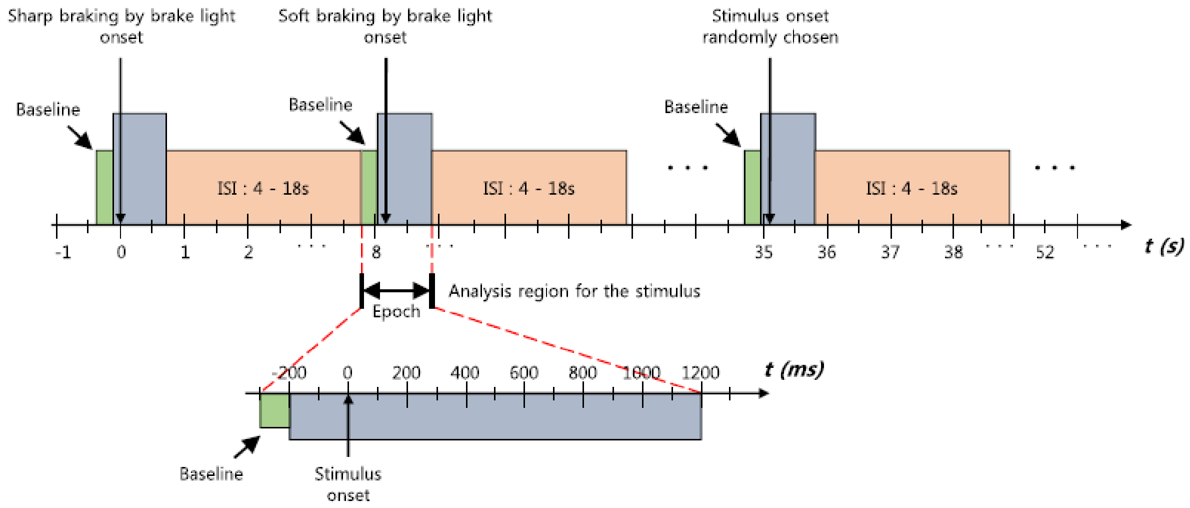

Figure 2. Timing scheme of the experimental paradigm.

Data recording

The EEG signals were recorded using a multi-channel EEG acquisition system from 64 scalp sites based on the modified International 10–20 system. We used Ag/AgCl sensors mounted on a cap (actiCAP, Brain Products, Germany). The ground and reference electrodes were located on scalp position AFz and the nose, respectively. The sampling rate was 1000 Hz throughout the experiments. Electromyographic (EMG) signals were acquired using a unipolar montage at the tibialis anterior muscle. The impedances of the EEG and EMG electrodes were below 10 kΩ. The EEG and EMG data were amplified and digitized using BrainAmp hardware (Brain Products, Germany).

Data file description

We provide raw data that can be converted to any form. All data sets are basically stored in the General Data Format for biomedical signals, one file per subject. Each subject in the one folder contains three pieces of data. The EEG data is stored in a binary .eeg file. It consists of 8-channels which all “measured” a sinusoid signal. The files with .vhdr and .vmrk directly belong to the .eeg file specifying additional information. In contrast to the actual data, they are not in a binary format, so you can open them. The vhdr-file contains general additional information and the vmrk file contains name and time point of the markers you see above.