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Designing an Emotional Stroop Task for Facial Arousal Judgments under Pseudo-Heartbeat Vibrotactile Stimulation

Tamaki Fujieda
University of Tsukuba
Ibaraki, Japan
fujieda@ah.iit.tsukuba.ac.jp

Ryotaro Ishikawa
University of Tsukuba
Ibaraki, Japan
ishikawa@ah.iit.tsukuba.ac.jp

Soichiro Matsuda
University of Tsukuba
Ibaraki, Japan
matsuda@human.tsukuba.ac.jp

Taku Hachisu
University of Tsukuba
Ibaraki, Japan
hachisu@iit.tsukuba.ac.jp

I. Introduction

This demonstration presents an emotional Stroop task to objectively and quantitatively evaluate the capacity to associate perceived pseudo-heartbeat stimuli with emotional states. The Stroop task has been widely adopted to evaluate cognitive abilities [1], [2]. In the original Stroop task, participants are instructed to quickly name the ink color of a presented color word [1]. When the meaning of the word and the ink color is incongruent, the response times are longer than when they are congruent.

We design an emotional Stroop task, in which participants are asked to judge the emotion conveyed by a facial expression, following exposure to a pseudo-heartbeat vibrotactile stimulus (Fig. 1). Assuming that pseudo-heartbeat stimuli simulating increased or decreased heart rates automatically induce aroused or sleepy emotions, respectively, we hypothesize that response times will be longer when the emotion induced by the pseudo-heartbeat stimulus and facial expression are incongruent, rather than congruent.

II. Setup

The system consists of a bracelet-type device, a monitor, an audio amplifier, and a host computer. The bracelet-type device incorporates a voice-coil actuator (Acouve Laboratory, Vibro-Transducer Vp210) housed in a 3D-printed polylactic acid case (Ultimaker, Ultimaker S5 Pro). A Velcro band fastens the device to the participant's wrist. The computer runs the program, displays instructions and facial expressions on the monitor, outputs audio signals via an amplifier (FX-AUDIO FX202A/FX-36A PRO) to the actuator, and records participants' responses.

A. Pseudo-Heartbeat Vibrotactile Stimuli

The bracelet-type device generates the pseudo-heartbeat vibration stimuli. We employ two levels of pseudo-heartbeat vibrotactile stimuli: 1) Tactile Aroused Stimulus; and 2) Tactile Sleepy Stimulus, in which the heart rate is set to 60/120 BPM for the first 2.5 seconds, then linearly increased/decreased to 120/60 BPM over nine beats, and subsequently held at 120/60 BPM.

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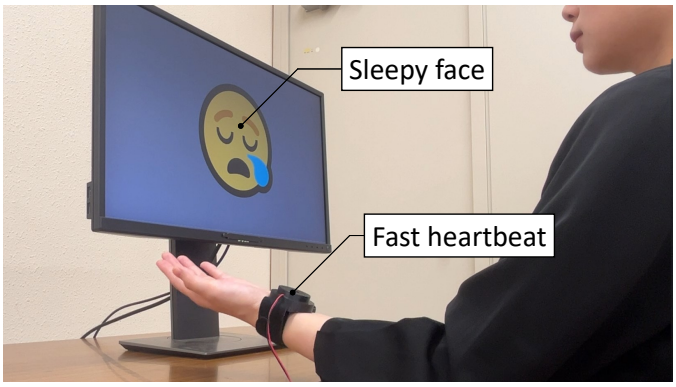

Fig. 1. Emotional Stroop task: A participant is asked to provide a binary response ("awake" or "sleepy") regarding the facial stimulus as quickly as possible, following exposure to a pseudo-heartbeat vibrotactile stimulus.

B. Facial Expression Stimuli

We employ two levels of frontal faces: 1) Visual Aroused Stimulus; and 2) Visual Sleepy Stimulus, in which standard Microsoft Windows 10 Surprise/Sleepy emoji are used.

C. Procedure

Each trial proceeded as follows. A central fixation point appears on the monitor, and the system begins delivering the pseudo-heartbeat vibrotactile stimulus. At the tenth beat (after 8.4 – 8.7 seconds), a facial stimulus appears on the monitor. Finally, participants are asked to quickly provide a binary response ("awake" or "sleepy") regarding the facial stimulus.

Using two levels of the facial expressions and two levels of pseudo-heartbeat vibrotactile stimuli, we created Congruent and Incongruent conditions.

Based on this design, we hypothesized that if emotion recall from a pseudo-heartbeat stimulus is as automatic as that from a facial expression, response times would be longer in the incongruent than in the congruent condition.

References

[1] J. R. Stroop, "Studies of interference in serial verbal reactions." *Journal of experimental psychology*, vol. 18, no. 6, p. 643, 1935.

[2] A. I. Agustí, E. Satorres, A. Pitarque, and J. C. Meléndez, "An emotional stroop task with faces and words. a comparison of young and older adults," *Consciousness and Cognition*, vol. 53, pp. 99–104, 2017.