Offline Temporal Dominance of Emotions Method using Recorded Videos

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***Abstract*—The Temporal Dominance of Emotions (TDE) method records the temporal evolution of multiple types emotions experienced by individuals. Traditionally, TDE has been primarily applied in food sciences, relying on button-pressing tasks that require visual recognition and active hand control while receiving sensory stimuli. To extend the application of TDE to user experience evaluation in consumer electronics, we introduce an offline TDE method where users assess emotions by watching recorded videos of their experiences. We tested this method using two types of games. Nine participants assessed their emotions during both the gameplay (online TDE) and video review (offline TDE) sessions for a mini-shooting game and Tetris. We analyzed the frequency of emotional changes between the online (real-time) and offline (video-review) conditions. Participants reported more frequent emotional changes when watching recorded videos of their Tetris gameplay. The reported emotions during the online and offline conditions coincided approximately 30–40% of the time for both games. These findings suggest that the effectiveness of the offline TDE method depends on the specific context, and that certain measures may be needed to enhance the recall of emotions.**

***Index Terms*—Temporal dominance of emotions, video game, user experience**

I. Introduction

The Temporal Dominance of Emotions (TDE) method [1] assesses the transient evolution of consumer emotions over time. It builds upon the Temporal Dominance of Sensations (TDS) method [2], [3], which captures dynamically changing sensations, typically during food tasting. Although TDS and TDE have been primarily applied in food science [4]–[6], they have also been extended to non-food-related stimuli [7]–[10]. For example, Kantono et al. [7] investigated the relationship between music and flavors using TDS, while Peltier et al. [8] assessed the impact of coffee advertisements on consumers' emotions using TDE.

Despite nearly a decade of development, TDE has not been widely applied to experiences where real-time reporting is challenging. Typically, TDE tasks require users to focus on a computer panel and press buttons to promptly report emotions, making it unsuitable for tasks that demand constant visual and manual engagement.

In this study, we propose an offline TDE method to assess emotional changes during tasks that require visual attention and manual control, with video games serving as the example. Ten emotional attributes were evaluated in two stages: during real-time gameplay (online TDE) and while watching a video recording of the gameplay (offline TDE). This study is the first to assess the effectiveness of offline TDE in recalling emotional experiences during such tasks.

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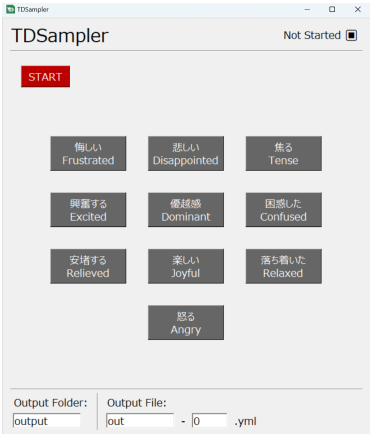

Fig. 1: Graphical interface used in the TDE tasks. Each button represents an emotional attribute.

II. Methods

A. Temporal dominance of emotions (TDE) method

The TDE method [1] was utilized in our study to record the evolution of dominant emotions perceived during gameplay. A graphical user interface, as shown in Fig. 1, was employed for the TDE task. Ten types of emotions were investigated: "frustrated," "excited," "relieved," "tense," "joyful," "angry," "dominant," "disappointed," "relaxed," and "confused." These emotional attributes were provided in both English and Japanese, the participants' native language.

At the start of the game, participants pressed the start button. They then selected the button corresponding to the emotion that best described their most dominant emotion at each moment. Once a button was pressed, it remained selected until another emotion was chosen. The timestamps of each button press were recorded throughout the task. Participants pressed the stop button to end the evaluation when the game concluded or when the time was up.

This procedure was repeated twice for each game session: once during real-time gameplay and once during the review of the recorded gameplay. While watching the recordings,

participants were instructed to recall the emotional changes they experienced during gameplay, rather than evaluating their emotions while viewing the footage.

B. Gamification as stimuli

Two smartphone-compatible games were selected for the study: a shooting game and Tetris. Both games feature simple controls, enabling players to assess their emotions using the TDE method with one hand while playing with the other. In the shooting game, players must avoid enemy bombs and attack enemies. In Tetris, players perform more complex operations such as rotating, positioning, and accelerating blocks. These games are capable of evoking a range of emotions, from negative ones like frustration and tension to positive ones such as joy.

C. Participants

Nine university students (mean age: 23.0) participated after providing informed consent.

D. Procedures

Initially, participants were asked to familiarize themselves with the ten attributes and the layout of buttons on the TDE panel to ensure smooth performance of the TDE tasks. If uncertain, they were allowed to discuss the meanings of the attributes with the experimenter. The arrangement of the attribute labels on the buttons was randomized across participants.

They then had a one-minute trial session to practice the controls of the mini-shooting game. Subsequently, they played the shooting game while simultaneously performing the real-time emotional assessment, which took approximately three minutes. Immediately after game-play, that is, within 1 minute, participants watched the video recording of their mini-shooting game and conducted another round which is termed offline TDE task. They were required to recall the emotions they felt while playing the game in the online TDE task rather than assessing the emotions they felt though the video. The same protocol was adopted for Tetris, with a two-minute time limit.

E. Data analysis

a) Button-pressing times: To compare the frequency of emotional evaluations between the online (real-time) and offline sessions, we calculated the number of button presses for each participant in both conditions. These frequencies were then compared using a paired t-test."

b) Concordance proportion of emotional evaluations: We calculated the concordance of reported emotions between the online and offline sessions. For each emotion at an arbitrary time t, $x_i^{(\mathrm{on})}(t) \in \{0, 1\}$ and $x_i^{(\mathrm{off})}(t) \in \{0, 1\}$ indicate whether the ith ($i \in \{1, ..., 10\}$) emotional attribute was selected (1) or not (0) in the online and offline TDE tasks, respectively. The concordance proportion was calculated by:

$$C_i = \frac{1}{T} \int_0^T x_i^{(\mathrm{on})}(t)\ x_i^{(\mathrm{off})}(t)\ dt, \tag{1}$$

where T is the duration of each TDE task. To calculate the overall concordance, we summed the C_i values across all types of emotions. Hence the overall concordance is determined as follows:

$$\sum_{i=1}^{10} C_i. \tag{2}$$

The concordance is conceptually similar to the similarity of TDE tasks [11], which tolerates small temporal mismatches between tasks.

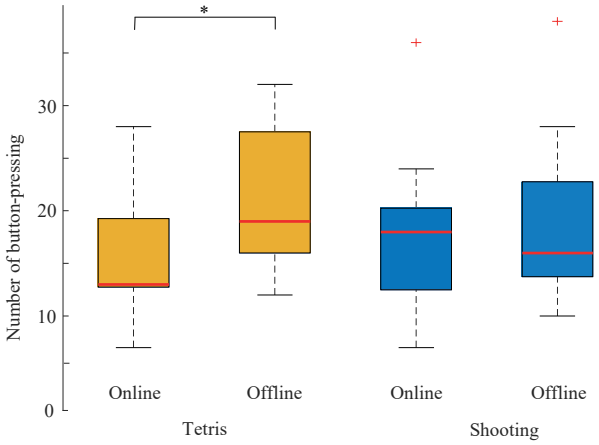

Fig. 2: Boxplot of number of button-pressing.

III. Results

Fig. 2 shows the number of button-pressing during the TDE tasks. For Tetris, the participants reported more frequent changes of emotions during the offline condition than the online condition ($t(8) = 2.79$, $p = 0.019$). In contrast, for the shooting game, no significant differences were found between the online and offline conditions ($t(8) = -1.04$, $p = 0.304$).

The averages and standard deviations of the concordance proportions among all the participants were 0.412 ± 0.13 and 0.337 ± 0.15 for Tetris and the shooting game, respectively. They were comparable to each other and no significant difference was observed ($t(8) = 1.60$, $p = 0.25$).

IV. Discussion

The experiment with Tetris revealed a significant difference in the frequency of emotional evaluations between the online and offline conditions. This difference is likely due to the complex operations required in Tetris, which may have prevented participants from reporting emotional changes as frequently as they experienced them during the online task.

The concordance proportions between the online and offline tasks were approximately 0.3 to 0.4. While specific benchmarks for these values have not been established, they may be considered less than satisfactory. To improve these values, the experimental protocol could be modified to include additional participant training.

For example, before the main experiment, participants could perform trial TDE tasks using a different game, receive feedback on the TDE data, and discuss discrepancies in their responses between the online and offline conditions. This

approach would help ensure that participants can accurately identify and report their emotional changes using the TDE method.

Further, while our analysis provides initial insights into the offline TDE task, future studies should employ more flexible analytical methods to capture the full complexity of emotional responses.

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