Effects of Angry Birds-like Live Streaming on Working Memory

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***Abstract*—This paper investigates whether and to which degree watching Angry Birds-like live streaming could affect the spectator's working memory (WM). We prepared Angry Birds-like gameplay on the Twitch streaming platform in which a domino effect based on Rube Goldberg Machine (RGM) mechanism is featured in each generated game level. The spectators' working memory are measured using the N-back task, and our results show a possibility that watching the proposed live streaming can increase the WM performance.**

***Index Terms*—Angry Birds, working memory, spectator, Rube Goldberg Machine**

I. Introduction

Working memory (WM) refers to the system involving the temporary storage of information that maintains the process of specific cognitive tasks [1]. The performance of WM corresponds with higher cognitive tasks such as complex learning or reasoning and WM capacity related to the capability of using attention to maintain information or avoid distraction [2]. Previous studies revealed that specific emotional states [3] or acute stress [4] induced by watching videos of showing parts of movies could affect spectator's WM performance. Based on the aforementioned work, we are curious to know if watching videos of other kinds, such as gameplay, could also affect spectator's WM performance.

In this study, we investigate whether watching videos of interesting gameplay could lead to positive effects on performance in WM tasks. We note that, in our prior study, showing an interesting explosion in Angry Birds-like game was found to statistically significantly decrease the negative affect and promote better emotion of spectators [5]. In the current study, we hypothesize that watching interesting Angry Birds-like live streaming would increase the spectator's WM performance.

II. Methodology

A. The Stanford Sleepiness Scale

The Stanford Sleepiness Scale (SSS), developed by Hoddes et al. in 1972, is a one-item self-report questionnaire measuring levels of sleepiness throughout the day [6]. The SSS is presented in a seven-point Likert scale ranging from 1 (feeling active, vital, alert, or wide awake) to 7 (no longer fighting sleep, sleep onset soon).

The SSS was used in Jiménez et al.'s study [7] to screen their participants before performing mental demanding tasks: 3-back or oddball task. The participants were required to score ≤ 3 on the SSS upon their arrival at the experiment place.

B. N-back Task

The N-back task is a WM-related task that had been used to measure the WM performance [3] [4]. A study by Gray et al. strengthened the evidence that participants' unpleasant emotional state improves the spatial N-back performance and decrease the verbal N-back performance, while the pleasant one works in the opposite way. Another study by Qin et al. [4] found that an acute stress induced by watching movie clips with aversive content could significantly reduce participants' N-back performance.

C. Science Birds Live Streaming

This study is conducted using an extended version of Science Birds from our prior study [5]. Science Birds is a clone version of Angry Bird widely employed for academic research [8]. We presented our Science Birds gameplay via the Twitch online streaming platform. Our previous study found that proper placement of a TNT (in-game explosive object) contributes to in increase in the interestingness of an Angry Birds video and helps the participants reduce their negative affect [5]. Based on this finding, this study features a procedurally generated level with a *domino effect* based on Rube Goldberg Machine (RGM) mechanisms (Fig 1). We calculate projectile motions for bird-shooting based on in-game gravity, the bird starting position, and the target position.

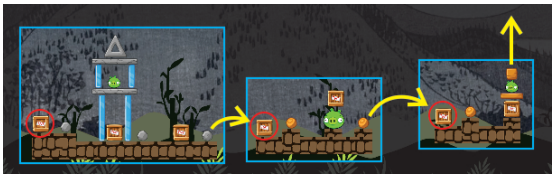

Fig. 1. An example of an RGM level. There are three segments in this level, those surrounded by blue rectangles. A segment contains a trigger object (red circle) that when it is destroyed it will make a particular object to fly (yellow arrow) and destroy the next segment's trigger object. The process will be chained until all available segments are destroyed.

III. Experiment

A. Participants

Participants were 14 healthy university students at our university. All participants provided their informed consent

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