Visual distractors can measure game attention

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Introduction

The computer games industry is an uncertain business driven by the search for "hits". The game *Candy Crush Saga* was created by *King Digital Entertainment.* The company has also made 200 other games but none have come close to *Candy Crush Saga* in earning potential (BBC, 2015). Similarly, the company *Rovio* created 51 games before having a hit with *Angry Birds* (Cheshire, 2011). Being able to reliably assess players' experience of playing games would reduce this uncertainty and make the industry more stable.

Many researchers have investigated ways of measuring the experience of playing games. Questionnaire measures ask people about their experience after playing the game (Mäyrä and Ermi, 2005, Jennett et al., 2008). They have had some success, but are reliant on the player's own perception of their experience. Psychophysiological approaches measure physical properties of the body that may change due to the game experience (Ambinder, 2011, Nacke, 2009). However, it can be difficult to interpret what these measures actually mean for game experience. For example, if skin conductance rises during gameplay what does that say about the game experience?

One of the defining features of the experience of playing games is the way that they hold our attention and stop us getting distracted by external events. This study investigated a novel way of measuring how well a game holds players' attention.

Audio distractors have been used to measure how immersed players are in a game. Brockmyer et al. (2009) played the same audio distractor to game players several times and noted whether they responded to the distractor and how quickly. Jennett (2010) played 9 different audio distractors to participants during a 10 minute game. She then asked them to recall which distractors they remembered hearing during the game. Lavie et al. (2004) showed that people are less likely to be distracted by visual or audio distractors (Raveh and Lavie, 2015) when under high cognitive load. This suggests that the attention system may treat visual and audio distraction in a similar way and that it should be possible to use visual distractors to measure how strongly players' attention is held by a game.

Standing (1973) showed participants a large number of images in turn and then tested how well they recalled those images. They remembered around 90% of the images they were shown. This high level of visual recall suggested that I could use a similar method to see if participants have noticed a visual distractor. In contrast, Miller and Tanis (1971) found that participants only remembered 75% of an audio stimuli consisting of common words. This suggested that visual recall might be more reliable than audio recall.

Experiment

This experiment aimed to measure how well two different games hold players' attention. Participants played either a successful self-paced "good" game or a "bad" game. Both of these games were surrounded with regularly changing visual distractors. At the end of the game, participants were tested on how many distractor symbols they remembered.

Hypothesis

The hypothesis of the experiment was that the number of distractors that participants remember will be higher for the "bad" condition than the "good" condition. The null hypothesis is that there will be no difference between the number of symbols remembered.

Method

Design

This was a between-subjects design with two conditions and 20 participants. The independent variable was the game that each participant undertook: either the good game or the bad game. The main dependent variable was the number of distractor symbols that participants' remember seeing after the activity. Another, secondary dependent variable is the Immersion Experience Questionnaire (IEQ) (Jennett et al., 2008) score for each participant's experience of the game.

Materials

The good game used for this study was a clone of the popular mobile game *Two Dots* This is a very successful (Crook, 2014) self-paced game with a simple graphic style and the minimum of additional rewards and bonuses (http://weplaydots.com/twodots/). The bad game featured the same grid of dots as *Two Dots* but with all the "game elements" removed. This involved making the dots all the same colour and removing the levels, the move counter and targets. In both games, the sides of the screen contain distractor images made up of distractor symbols. These symbols were icons taken from the *Webdings* typeface. The symbols filled the left and right quarter of the screen so that altogether half of the screen was filled with symbols. They changed every 5 seconds without repeating.

Procedure

Participants played one game for 5 minutes, during this time they were shown 60 different distractor images. After playing the participants were tested to see how many images they remembered. The test had 30 trials. In each trial, the participant saw two images and had to indicate which one they had seen during the game. One image was a distractor symbol shown during the activity and the other was another symbol that had not been shown previously.

Results

There was a significant ($p<0.05$) difference in the number of correct symbols remembered between the good game (M=13.0, SD=3.1) and the bad game (M=19.4, SD= 3.9) conditions; $t(18)= -4.0$, p= $p<0.001$. There was an effect size (Cohen's *d*) between the two conditions of -1.8.

The purpose of the IEQ was to confirm that participants in each condition had had a different game experience, as indicated by different levels of immersion. There was a significant difference ($p<0.05$) in the immersion scores between the good game (M=110.2, SD=14.4) and the bad game (M= 84.6, SD= 10.8) conditions; $t(18)= 4.5$, $p<0.001$. There was an effect size (Cohen's *d*) between the two conditions of 2.0.

Discussion

The hypothesis that the number of symbols remembered by participants who played the bad game would be higher than the number remembered by those playing the good game was supported. The level of immersion for participants who played the good game was significantly higher than for those who played the bad game. This indicates that these participants had a significantly different game experience. These two results indicate that remembering distractors may be a useful measure for how well self-paced games hold players' attention.

The two activities in this study had large differences, so produced a strong difference in attention. Future studies could compare similar games with smaller design differences to investigate their ability to hold players' attention. This could give insight into the effect of small design changes on the game experience. To distinguish smaller changes in attention it may be necessary to make the symbols more distracting and memorable. Fast-paced action games may hold attention more than the self-paced game used in this study. This means that investigating action games may also need more distracting symbols. Animating the symbols would make them more distracting and using photos instead of symbols would make them more memorable. Eye movements are linked to changes in attention (Shepherd et al., 1986) so using eye tracking to record whether participants are looking at the game or the distractors could provide an alternative measure of attention.

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