Re-Twist: Evaluating Engagement in a Digitally Augmented Traditional Game

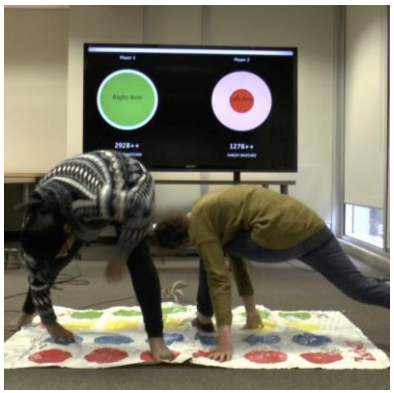

Figure 1: Participants playing Re-Twist, the digitally augmented version of Twister.

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Abstract
Digital adaptation of physical games often includes complete digitization resulting in the replacement of physical movements with virtual counterparts using input devices. We believe that augmenting the game by adding digital elements while also preserving physical movements can enhance player engagement. We present Re-Twist, a digitally augmented version of Twister. We introduce the element of *time* and *score* in Re-Twist by using a pressure-sensitive Twister mat that communicates with a projected screen. To investigate the effect of digital augmentation, we conducted a comparative study between the original Twister and Re-Twist. 81% of 16 participants preferred Re-Twist over the original Twister because of increased competition and urgency created by digital augmentation. We discuss the effect of digital augmentation on the competition, social, and challenge aspect of the game. This can guide new ways of game design by relooking at similar augmentation of other traditional games.

Author Keywords
Human-computer interaction; movement based games; exertion interfaces; digital augmentation

ACM Classification Keywords
• Human-centered computing~Human computer interaction (HCI)

Introduction

Works in the HCI field have studied engagement in game as a means to design better games for the players. Prior work has identified the body movement as an influencing factor in player engagement [3,6]. Games that combines digital and physical movements mostly incorporates either introducing a whole body interaction to a digital game [3,5,6] or digital augmentation to a physical game [1,10,13,14]. However, these studies have not focused on evaluating the effect of digital augmentation on engagement.

We present Re-Twist, a digital augmentation of the original Twister. We introduce the element of *time* and *score* as a dynamic feedback and visualization system. This creates a sense of urgency in the game that seems to influence player experience [14]. Re-Twist comprises a pressure-sensitive mat and a projected screen. The pressure sensors on the mat receive data to determine if the player is pressing on the correct targets, and the projected screen displays the feedback. We digitally augmented the original Twister by showing time and score on the projected screen using visualization (Figure 2). The players start to collect points as soon as they match the target and lose points otherwise.

To investigate the effect of this digital augmentation, we conducted a comparative study with 16 participants between the original Twister and Re-Twist. We found a higher preference (81%) in Re-Twist, and in terms of player engagement, Re-Twist created a more competitive and less social environment. Based on our user study, we discuss considerations related to social, competition, and challenge themes for the digitally augmented traditional game.

Related Work

Besides the potential of increasing engagement, our work intertwines physical and digital elements. Prior work demonstrates that introducing digital elements enables various movements, procedural content [14], changes the nature of the cooperative play [13], manipulates the pace of the game [14], and acts as a social icebreaker [10].

One approach of digital augmentation has been sensory augmentation using visual and sound elements without altering the structure of the physical game [13]. Several works have introduced digital elements to increase the complexity of the game [1,14]. We see this as an opportunity to look at various other traditional games and find new directions to enhance the experience of playing those games.

On the other hand, whole-body interaction has also been introduced to digital games in prior work to enhance player experience. A common approach is to use body tracking to control a component of a digital game [2,8,11,17]. Yet it requires extra space for an additional tracker which is not part of the game.

Previous work has defined and evaluated in several ways the engagement of the players with games. Components such as the competitive aspect of the game, difficulty, and camaraderie have been shown to increase the engagement [3,6]. To evaluate the engagement, some authors have used the Game Experience Questionnaire [4,9]. Physical games with digital augmentation and digital games with physical augmentation have been evaluated using surveys and interviews [4, 5, 10, 13].

Figure 2: The projected screen displays the score and the reducing size of the circle displays the time left for the next move to be displayed.

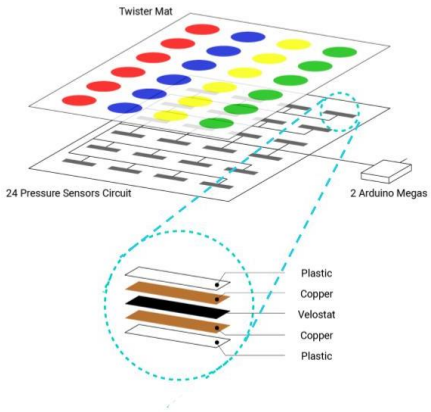

Figure 3: Prototype of the pressure activated Twister mat

Past work demonstrates that the confluence of physical movement and digital technologies influences the game-playing experience [14]. This suggests that traditional physical games can be investigated as a rich resource for digital augmentation. In this work we introduce a way of digitally augmenting Twister. To the best of our knowledge, no work has studied the impact of such digital augmentation on the engagement and playing experience. We intend to address this gap by augmenting Twister, a popular physical game, and comparing the engagement with the original version.

Design Rationale

We choose a whole-body game, Twister for the purpose of digital augmentation. Twister is a multi-person party game that was created in 1964, and has been a popular game ever since, as evidenced by being featured in TV shows [7,15]. Over the years, people have modified the game by adding layers like colour foam, paint, ketchup [16], and shot glasses [7] on the targets to increase the complexity and engagement of the game. This demonstrates the potential to accommodate additional layers while preserving the original structure of the game. Through digital augmentation, we aim to add the elements of time and score to increase the complexity and competition in the game. We hypothesize that adding these layers will increase the engagement, collaboration and competition of the game.

Re-Twist – Game Description

We augmented the original Twister mat by adding pressure sensors to it (See the next section for details of implementation). This enables tracking the current pressing positions while preserving the original gameplay, without the need for extra space to do so.

The spinner in the original game randomly selects a combination of limbs (left/right arm or foot) and colour (red, blue, yellow, green). By digitally augmenting the game, we offload the task of random selection to the computer and the result is displayed for both players on a projected screen in the front (Figure 1).

Each player has to reach the coloured target with the suggested limb displayed on the screen, the points start to increase when the player reaches the correct target. As soon as the combination changes, the player starts to lose points until they hit the correct coloured target. This adds the elements of time pressure and competition to the game [14].

Prototype

Pressure Sensitive Twister Mat

As shown in Figure 3, a pressure sensor is collocated and attached to the underside of the mat at the 24 targets. Each of the 24 sensors can detect if a player is pressing on it and send this information to the two Arduino Megas. The two Arduino Megas are in the master-slave type of connection to accommodate 24 input points for the sensors. We use Processing to receive and process the sensor data through serial communication, and in turn displays the relevant data on the projected screen. Each pressure sensor (5 cm X 17 cm) spans the diameter of the circular target and is made of two conductive layers of copper with a resistive velostat in between. Two layers of plastic seal these three layers on the top and the bottom. The sensor acts as a variable resistor as the pressure on the sensor modulates the amount of current passing between the conducting layer of copper [5,18].

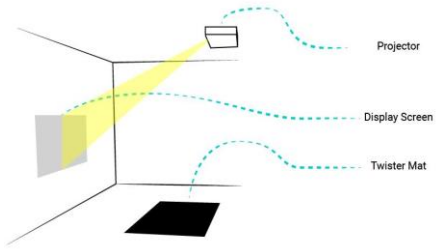

Figure 4: The experiment setup

The Projected Screen

The projected screen (Figure 2) comprises a circle for each player which determines the colour of the target (Red, Yellow, Green or Blue) and the text on the centre suggests the limb (Right Arm, Left Arm, Right Leg, Left Leg). The system randomly selects the combination of limbs and colours. The circle size reduces continuously until it disappears and the next combination of the limb and colour is displayed. The screen provides feedback if the scores are increasing or decreasing and if the player matches the right target or is on the wrong one. At the end of the game, when time runs out, the screen displays the final score, the winner, and the loser in the game based on the scores. The current implementation supports two simultaneous players.

Study

We conducted a within-subject comparative evaluation where the participants played the original Twister as a control condition and Re-Twist as the experiment condition. We counterbalanced by condition and the study lasted for 30 minutes.

Participants

We recruited 16 (9F, 7M) participants for our study. 8 participants were between the age of 17 and 25 and 8 participants were between the age of 26 and 39. 12 participants had previous experience playing Twister. We had two participants playing together for each session. 6 pairs of participants knew each other prior to the experiment, and two pairs did not know each other. We recruited through email and social media and participation was on a voluntary basis.

Experiment Setup

As shown in Figure 4, we placed the Twister mat on the floor. We asked the players to start the game by facing each other on the extreme ends of the mat and then move onto the mat according to the directions given by the referee in the original game and the screen in Re-Twist. For Re-Twist, the screen was projected on the wall in front of the mat.

Data Collection and Analysis

Our questions comprised of 15 five-point Likert scale questions for each condition. At the end of the experiment we asked a set of open-ended questions.

We based the Likert questions on the GEQ [12], where we selected the themes that were relevant to the traditional game and Re-Twist. These high level themes were: challenge, competition, positive, and negative emotions. Since most of the metrics in the literature focus on measuring the experience of the digital game, we looked further into the work of Costello. et. al. [6] to add questions that address the Social aspect of the game. These questions covered the aspect of connection and camaraderie with the other player.

For the open-ended questions, at the end of the experiment, we covered the role of the digital augmentation on the engagement of the participants. We also asked their preference between the two games and design suggestions for the digital game. All interview recordings were transcribed and analyzed.

P3: "*The time limit was the most challenging part of the game because if I was in a bad position it was hard to hit the target on time.*"

P4: "*I like the score of the digital game. I like to be able to tell who's winning through the game.*"

P9: "*So the spinner becomes part of the game as well so whenever we get something bad we could blame him and we could laugh about it.*"

Results

Overall, 13 out of 16 (81.25%) participants preferred Re-Twist over the original Twister. To test if the digital augmentation has an effect on each of the 5 themes, we performed a repeated measure two-way ANOVA with the game condition (Re-Twist and Twister) as the within-subject factor and the order of condition as the between-subject factor. There was a significant effect of digital augmentation on the competition theme with a large effect ($F(1,14) = 4.77$, $p = .047$, $\eta 2 = .254$) as well as for the social theme with a large effect ($F(1,14) = 11.01$, $p = .005$, $\eta 2 = .440$). There was no significant effect of digital augmentation on the challenge theme ($F(1,14) = 4.09$, $p = .063$, $\eta 2 = .226$) as well as for the positive theme ($F(1,14) = 6.26$, $p = .665$, $\eta 2 = .014$) and the negative theme ($F(1,14) = 1.22$, $p = .287$, $\eta 2 = .080$).

To test if winning or losing in the digital game had an effect on the positive and negative experience of the player, we performed an independent sample *t*-test for each with winning and losing as the between-subject factor. The difference between the winners and the losers for the positive experience was not significant with a very large effect, $t(14) = 2.08$, $p = .056$, $d = 1.036$. As for the negative experience, the difference between the winners and losers was also not significant but with a small effect, $t(14) = 0.5$, $p = .625$, $d = .026$.

Discussion

We found a statistically significant effect on the competition and the social theme based on the Likert scale questions. 81% of the participants preferred Re-Twist and gave positive feedback on the time and score aspects of the game.

Two Types of Engagement: Social and Competitive

We found that the combined roles of the running score and the visual representation of the timing created a new form of engagement with the game. The participants stated that they felt more competitive playing Re-Twist because of these two components (P4). On the other hand, while playing the original Twister the participants mentioned they felt more social since they could observe the other players' positions to laugh and make comments on it (P9).

The Perception of Challenge

The effect of digital augmentation was not statistically significant for the challenge theme. While discussing the perceived challenge, participants often talked about the complexity of body movements they had to perform rather than the digital components of the game. Thus, the perception of challenge was closely related to the combination of colour and limbs the player received and it weighed down the effect of digital augmentation. Despite that, a few participants explained that the primary challenge in both games was the body movement and holding difficult posture, but playing Re-Twist was more challenging because of the sense of urgency created by the *time* and *score* (P3).

Moreover, we did not find any significant effect on the winning or losing status of the participant. This demonstrates that winning and losing did not influence the game-playing experience of the participants.

Lessons Learned

We learned that digital augmentation could preserve the structure and feel of playing a traditional game. And adding time and score enabled conversations about winning, losing, and time left to hold a difficult position.

Limitations and Future Work

During the analysis of our data, we realized that the randomization effect of the moves could have affected our results, as some sequences of moves might be more difficult than the others. This matter also affected the camaraderie feeling, part of the social interaction, because participants found the positions funnier. To counter this effect, we could choose between pre-designed sequences of positions and level of difficulty at the start of the game.

Another way to see Re-Twist is a new approach towards whole body interaction. The literature for whole body interaction primarily includes body tracking [2,8,14], wearable sensors [1] and controllers [11]. We see tracking the limbs' positions on a pressure activated mat as a simplistic way of tracking and manipulating the body posture. An audio component could also be implemented to provide extra feedback to the players.

Adding the element of time and score to the original twister changes the game's mechanics. It is difficult to distinguish if participants felt more competitive due to digital augmentation or change in the game mechanics. It would be worthwhile to conduct a comparative evaluation with a version of Twister that is not digitally augmented but has the same elements of Re-Twist.

Lastly, to better understand the effect of digital augmentation on players' engagement with traditional games, we would like to digitally augment other traditional games. We are interested in physical games, but it could be interesting to also explore other types of game such as board games or puzzles.

Conclusion

In this paper we presented Re-Twist, which is a digitally augmented version of the traditional game of Twister, by introducing the element of time and score. We conducted a comparative study of Re-Twist and Twister to investigate the impact of such augmentation on player engagement, and showed that it led to an increase in the feeling of competition, but a reduction in social competition. We expect the features we incorporated in Re-Twist and our study results will help to guide new ways of game design for player engagement. We believe that the high preference of Re-Twist in our comparative evaluation shows promise for digital augmentation of traditional games.

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