Improving the Social Gaming Experience by Comparing Physical and Digital Tabletop Board Games

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ABSTRACT
Board game conversion to digital tabletops has the potential to create an exciting and immersive gaming experience. Digitization can reduce the amount of manual work by automating game mechanics, such as scorekeeping and housekeeping activities; thus, allowing players to focus on strategizing and socializing. However, automation can increase the potential for confusion, such as why counters were updated. To understand the impact of automation on the social gaming experience, we conducted a mixed-methods study comparing physical and digital tabletop versions of the board game Pandemic. We collected and analyzed both quantitative and qualitative data using statistical and video analyses. These analyses revealed many important and subtle differences between the physical and digital game versions that impacted the players' social experience. We proposed that our methodology may be useful for studying other types of physical and digital social games.

Author Keywords
Social gaming experience; digital tabletops; collaborative board games; automation; mixed-methods approach

ACM Classification Keywords
H.5.2 [User Interfaces]: Evaluation/methodology.

General Terms
Human Factors; Design; Experimentation; Measurement

INTRODUCTION

The digitization of board games has the potential to provide a more immersive environment, using game sound and animation, and to reduce the need to perform mundane or routine activities, such as shuffling or dealing cards and moving game pieces. Collaborative board games, such as Pandemic and Space Alert, will be used as a case study as they provide players a great chance to socialize while strategizing together.

Digital tabletops are interactive large horizontal surfaces that display content and support direct input on the surface. For example, the Microsoft Surface (Pixel Sense) and the SMART Table are commercially available tabletop products. Digital tabletops provide a promising platform for digital board gaming. Players are able to see each other's facial expression and gestures; the digital nature of the system provides added benefits, such as setting up and cleaning up the game, keeping track of the scores, and maintaining housekeeping activities to leave players free to form strategies and engage in conversation. Thus, digital tabletop board games have the potential to enable a social gaming experience by combining the advantages of traditional board games with digital capabilities.

Given the potential benefits, some opportunities for further research also arise. While digitization enables automations in gameplay, they can introduce confusion by making the game's behaviour difficult to follow. To further understand the impact of such automation, we conducted a study to compare players' gameplay and gaming experience on physical board games to digital versions of the same game.

Our goal of the study was to reveal how different games and platforms can change the social gaming experience. We followed a mixed-methods research methodology [3] that involved collecting and analyzing both qualitative and quantitative data. An open coding analysis process [5] was applied to the qualitative data. Timestamps of player actions related to the social aspect of the gameplay were recorded. Moreover, we compared the physical board game with the digital versions to investigate how to create a more engaging and social gaming experience.

Previous gaming research studies have employed different methodologies for evaluation. For example, heuristic evaluation [4] can provide a quick and relatively cheap way to evaluate games and A/B testing [1] can test a single variable using a large sample of participants. However, these techniques provide little insight into the social aspect of gameplay. To investigate this aspect, observations of people playing games and interviews or focus groups with gamers can be used [2,6]. Though field notes and transcription of game sessions can provide rich qualitative data, in-depth analysis is needed to find subtle changes in players' interactions and communication patterns, and to gain deep insights through immersion in the data.

The mixed-methods approach involving both analysis of game performance data and video coding of player behaviour allows researchers to describe the rich social gaming experience and interaction and use statistics to confirm the observations. The in-depth observations provided by the video data makes clear the trade-offs in game design and subtle differences across conditions. It also enables insights

Figure 1. The physical Pandemic game.

Figure 2. The high-automation Pandemic game.

into players' social interactions. This paper describes the methodology of our study as an example that uses this mixed-methods approach. Then, we present our video coding scheme and study results to demonstrate how it has provided a richer and deeper understanding of the player experience in both physical and digital board games. Finally, we discuss open questions and future research direction. We suggest that this methodology can be applied to other contexts to get a similarly deep understanding of the social experience of gaming. The methodology also produces both qualitative and quantitative data that can be used together to understand and measure the social gaming experience.

RESEARCH METHODOLOGY

To explore the social gaming experience, we conducted a mixed-methods study using the collaborative board game, Pandemic, as a test case. Three conditions were tested, varying the setup and amount of automation: one physical version with the traditional board game and two digital versions with low and high-automation on an interactive tabletop. Twelve groups of three participants played all three versions of the game in a laboratory setting. Preliminary results from this work have been published [7]. This section highlights relevant information to explain our methodology.

Conditions

In the *physical condition*, we used a commercial board game, Pandemic (Figure 1). In the Pandemic game, three to four players work together to find cures to four diseases to save the world from epidemic outbreaks. One of the challenges in the game is to manage resources to find the ultimate cure while keeping the infections under control. Players lose the game if they run out of time (the set number of cards in a pile they draw from) or if the infections get out of control (i.e., exceed the number of allowed outbreaks).

The digital versions provide different levels of automation in the game and both are played on digital tables. The *low-automation version* is a direct translation from the physical game. All the game pieces can be positioned anywhere on the display, despite whether the move is legal. Some actions that are cumbersome to perform on a 2D interface were automated, such as shuffling the deck of cards.

The *high-automation version* (Figure 2) automates many of the game events, such as distributing diseases and resolving special game events, and players are only able to move the game pieces according to the rules of the game. It also handles scorekeeping, drawing cards, and house keeping activities, such as updating counters. The changes caused by the game automation are shown through animations.

Data Collection

During the study, we collected the following qualitative and quantitative data: video and audio recording of the game play, screen capture of game sessions, and computer logs of the user interaction. Participants also completed a background questionnaire and a post-condition questionnaire after each game session.

Data Analysis

To fully understand the subtle differences in behaviour and social gaming experiences between the physical version and the two digital versions, we performed an in-depth video analysis. We used an open-coding process [5] to identify interesting player actions. Open coding is an iterative process in which the researcher starts with an initial set of codes (i.e., interesting actions), then codes the video data (i.e., records when interesting actions happen), and then revises and re-codes the video as more data are processed. This process produces a list of timestamps for all the interesting actions. They were summed up to produce counts of certain player actions and analyzed using repeated measures ANOVA statistical tests. The timestamps were also used to extract quotations and find examples for interesting actions. In summary, from the in-depth video coding analysis, we were able to extract both qualitative and quantitative data.

We deemed actions and incidents to be "interesting" when they indicated changes in communication patterns that may impact players' social gaming experience. Specifically, we examined moments of confusion, undo actions, narration, and laughs. The coding scheme and the results will be discussed in-depth below.

The rest of the data collected were analyzed quantitatively. The computer log data were used to analyze each player's

contribution to the collaboration. The questionnaires asked players to rate their gameplay experience, such as level of contribution, understanding of the game actions, and enjoyment, on a 7-point Likert scale. A Friedman's statistical test was used to analyze questionnaire data.

CODING SCHEME AND RESULTS

In this section, we will highlight the coding scheme and results related to the social aspect of the study.

Confusion

Even though the high-automation game required less effort to play, the chances of confusion increased. In the video analysis, we coded instances of confusion and long pauses during gameplay. We were able to record the number of times players were confused and when the confusion and long pauses happened in the gameplay. The data revealed that, after the animation displayed changes caused by a special event, players often had to look around to search for these changes on the game board. They also made exclamations to show their confusion or paused at length to process the changes. The long pauses are a notable exception in player behavior, as players usually talked non-stop throughout play. After pausing to process changes, players had to engage in further discussion with one another to update and validate their shared understanding of the game state; this discussion sometimes turned into heated debate. Thus, such confusion can negatively impact the social gaming experience and create frustration during gameplay.

Rule Consultation and Undo

One potential benefit of introducing automation is to have a set rule and relieve players from memorizing all of the rules. To examine the potential benefits and drawbacks of rule enforcement, we coded instances of consulting the rulebook, discussing rules, confusion about rule enforcement, and attempts to undo actions. The results showed that undo actions are performed not only for correcting wrong moves, but players often used physical game pieces to test strategies and communicate their ideas to one another. However, no undo functionality was provided in the high-automation version of the game, as this was considered a breach of the rules. Thus, when players attempted to test their strategies in the high-automation version, they sometimes ended up executing the strategy before they intended. Thus, a trade-off exists between providing constraints in the game to enforce rules, and providing the flexibility necessary to support communication strategies between players.

Use of Speech

We were also interested in whether the communication patterns changed across different conditions. To do so, we coded instances of narration, counting, and jokes players made. The data analysis revealed subtle differences in the purpose of narration. In the physical version, players narrated game events to announce what was about to happen as they carried out actions. On the other hand, in the high-automation version, players just reacted to changes and reported them. This result demonstrates a different level of engagement in the game. Finally, the analysis showed that most of the jokes players made were game-related. This leads us to believe that improving players' interaction with the game and better facilitating the decision-making progress can enhance players' social gaming experience.

Benefits of the Methodology

The results of the study show several benefits of the methodology. The observations revealed how well players understood the game animation and what coping mechanisms they used to deal with confusion. Compared to self-reported data from questionnaires and interviews, these observations provided a more direct data source of player's responses. Based on the coding results, we were able to identify particular system actions that created confusion, to compare occurrences across conditions, and to find out the reason.

The video coding analysis also helped us investigate potential trade-offs in the game design and subtle differences across conditions. Finally, researchers were able to become immersed in the gameplay to better understand the social interactions between players.

CHALLENGES AND OPEN RESEARCH QUESTIONS

Through the comparative study between the physical game and the digital versions with different levels of automation, we found that the low-automation version required too much effort to play, while the high-automation version reduced the effort at the cost of player's enjoyment of the game. Players need to feel in control and engaged during the gameplay through system feedback, but not be required to maintain the game state manually. The question of what should be automated and what should not still requires further investigation. The data analyses revealed that the current animations are too brief, and the system does not provide a way for players to find the changes easily. Moreover, players cannot control the start time of animation or step through automation feedback at their own pace. These factors all impacted player's enjoyment of the game. Thus, our analyses reveal some of the pitfalls in the current design and provide a better understanding of the problems. As a next step, we would like to improve the animation used for automation feedback, provide a visualization mechanism for changes in game state, and adjust the level of automation and flexibility in the gameplay.

We found that directly translating the physical game into a digital platform does not recreate the same gaming experience as playing the physical game. On the other hand, when automation is introduced to the game, we found that the game became less flexible even though it supported many attributes that we designed. For example, the game reduces the amount of mundane activities and rule memorization players have to do. The goal of digitizing is not to recreate the same experience but to improve the gaming experience by utilizing digital capability of the systems. Thus, conver-

sion of physical games should not be limited to just a direct translation, but with the goal of providing a more social, engaging, and enjoyable gaming experience.

Our methodology of comparing physical and digital games with extensive observation through an open coding process provides a way to gain deep understanding of the social interactions among players and their use of the technology. We were able to notice the subtle differences across physical and digital games and found that social gaming experience can be improved through better support on the decision making process. This methodology can be applied to other physical game conversion, such as treasure hunts, card games, and sports games. A possible future direction would be to improve the engagement and immersion of the game by getting players to be more proactive rather than reactive. The game design also needs to facilitate the decision making process by allowing more flexibility.

From the data analysis process, we were able to extract quotations and examples that represent or signal potential behaviour changes. The statistical analysis was used to confirm such observations and point out potentially interesting directions for other data analyses. This approach to investigating the changes in social gaming experience across different conditions allowed us to gain a deeper understanding of the gameplay experience. By using quotations and examples of players' behaviour, we are able to describe players' interaction with others and with the game in a richer medium to communicate these findings.

Compared to using performance data, error rate, or response rate, we believe that social interaction and gaming experience are so complex that numbers alone cannot fully describe players' intentions, subtle behaviour changes, coping strategies, and social interactions. Moreover, through watching and observing the gameplay repeatedly, researchers gain a unique understanding and insight into the interactions, gameplay, and players' characteristics. In a collaborative game setting, players verbalize their internal thought process and emotions to strategize, engage in conversation, and express confusion. Observations of their conversations, interactions, gestures, pauses, and body language can all be used to evaluate the social gaming experience.

Despite all the benefits of deeper understanding and a richer dataset, this methodology is very time consuming. The open coding process requires several passes on the coding scheme until it captures the essence of interesting behaviour, and the same video may need to be coded repeatedly for each new coding scheme. Moreover, the technical details also matter, such as the quality of the audio and video recording. The researchers also need to be neutral and make unbiased observations. However, this investment of time and effort can produce a rich analysis that provides an in-depth understanding of players' gaming experience, social interactions, and the subtle differences in how people use the technology. We also believe that qualitative data should be valued and used to describe players' gaming experience.

FUTURE DIRECTION

Our future research will be furthering this investigation on the social aspect of the gameplay through improvements to the visualization of game automation, to better convey changes. We will attempt to balance automation and user control, and to facilitate players' decision-making processes. Moreover, we will make use of audio recording software and computer logging software developed by our colleagues to reduce the time needed for the coding process.

WORKSHOP GOALS

We would like to share and discuss with other researchers in the gaming field our approach of using video coding analysis to evaluate the social gaming experience. We also hope to receive feedback on our future studies and learn new methodologies that can be incorporated into this work.

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