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It Matters Who's Watching: The Impacts of Surveillance on Business Board Games

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It Matters Who's Watching: The Impacts of Surveillance on Business Board Games

An Interactive Qualifying Project Final Report

Submitted to

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IT MATTERS WHO'S WATCHING: THE IMPACTS OF SURVEILLANCE ON BUSINESS BOARD GAMES

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TABLE OF CONTENTS

Contents

List of Figures	1
List of Tables	2
Executive Summary	3
Blending Change Navigator	3
Assessing the Impacts of Surveillance	4
Pilot Testing and Modeling Our Methods	4
Results of A Feasible Method	6
<i>Implications of a Small Sample Size</i>	6
<i>Questionnaire</i>	7
<i>Interviews</i>	7
Future Implementation of Our Method	8
Abstract	11
Acknowledgements	12
Introduction	14
Background	18
Business Games: Play in a Risk-Free Environment	18
Using Business Games to Address Change in the Workplace	19
A Change-Focused Business Game: <i>Change Navigator</i>	20
Improving <i>Change Navigator</i>	22
<i>Co-Creator</i>	24
Characteristics to Consider in Designing Business Games	26
Blending Physical Board Games with Digital Technology	28
Impacts of Surveillance on Gameplay	31
Evaluating the Impacts of Surveillance on Gameplay	33
<i>Video Observations</i>	33
<i>Pretesting and Posttesting</i>	34
<i>GEQ & SPGQ Questionnaires</i>	35
<i>Interviews</i>	36

TABLE OF CONTENTS

<i>Think Aloud Protocol</i>	37
<i>Heuristic</i>	37
Methods	38
Objective 1: Pilot Testing Potential Methods	39
<i>Testing Population</i>	41
<i>Simulation of Non-Blended and “Blended” Board Games</i>	42
<i>Videotaping Gameplay Decision-Making</i>	44
<i>Evaluating Personal Gaming Experience and Social Presence through Questionnaires</i>	47
<i>Interviewing Players for a More Complete Understanding</i>	49
Objective 2: Assessing the Impacts of Surveillance	50
<i>Generation of Random Gameplay Data</i>	51
<i>Analyzing Gameplay Data</i>	53
<i>Analyzing Questionnaire Data</i>	56
<i>Analyzing Group Interview Data</i>	58
Results and Analysis	59
Objective 1: Pilot Testing Results	59
<i>Inconsistent Order of Testing Instruments</i>	59
<i>Pre-play Instructions</i>	59
<i>Video Observations</i>	61
<i>Calculating Resource Fractions</i>	63
<i>Calculating Riskiness of Solutions</i>	64
<i>Questionnaire</i>	68
<i>Interview</i>	69
Objective 2: Results of Analyzing the Impacts of Surveillance	78
<i>Gameplay Data</i>	79
<i>Risk Score of Groups’ Solutions</i>	79
<i>Resource Fraction T-Test</i>	80
<i>Delay Card T-Test</i>	80
<i>Game Score T-Test</i>	81
<i>Questionnaire</i>	83

TABLE OF CONTENTS

<i>Questionnaire: Likert Scale T-Test for WPI Students</i>	83
<i>Questionnaire: Likert-type for WPI Students</i>	88
Conclusions and Recommendations	94
References	98
Appendices	101
Appendix A: Written Consent Form	101
Appendix B: Co-Creator Pre-Play Instructions	102
Appendix C: Co-Creator Gameplay Tracking Sheet	103
Appendix D: Co-Creator Risk Ranking of Challenges	107
Appendix E: Change Navigator Gameplay Tracking Sheet	116
Appendix F: Co-Creator Questionnaire	118
Appendix G: Change Navigator Questionnaire	121
Appendix H: Co-Creator Interview Questions	124
Appendix I: Coded Interview Sheet	125
Appendix J: Change Navigator Interview Questions	126
Appendix K: Java Code For Generation Of Random Co-Creator Data	127
Appendix L: Pilot Test Resource Fraction	154
Appendix M: Co-Creator Pilot Test Solutions and Scores	156
Appendix N: Co-Creator Pre-Play Instructions (Revised)	159
Appendix O: Co-Creator Pilot Test Round 1 Risk Ranking	160
Appendix P: Co-Creator Interview Questions (Revised)	165
Appendix Q: Co-Creator Interview Coded Responses	166
Appendix R: Questionnaire: Likert-type Frequency Breakdown	172

LIST OF FIGURES

List of Figures

Figure 1: (a) <i>Change Navigator</i> Impact Assessment (b) <i>Change Navigator</i> Change Fuel (c) <i>Change Navigator</i> Stakeholder Analysis.....	21
Figure 2: (a) <i>Change Navigator</i> Change Attitude (b) <i>Change Navigator</i> Leadership Actions.....	22
Figure 3: <i>Co-Creator</i> Success Parameters.....	24
Figure 4: (a) <i>Co-Creator</i> Challenge and Solutions (b) <i>Co-Creator</i> Resource Cards.....	25
Figure 5: Project Timeline.....	39
Figure 6: (a) Non-Blended Configuration (b) "Blended" Configuration.....	42
Figure 7: Potential "Blended" Configuration.....	43
Figure 8: <i>Co-Creator</i> Delay Card.....	46
Figure 9: Assessing Player Decision Making: (a) Risky Change Fuel Use (b) Safer Change Fuel Use (c) Performance Impact Score.....	47
Figure 10: Flowchart of Methods, Results, and Data Analyses.....	51
Figure 11: Example Resource Fraction Calculation.....	53
Figure 12: Visualization of Resources.....	60
Figure 13: Obstructing View of Game Board.....	62
Figure 14: Risk Ranking of <i>Co-Creator</i> Solutions By Percentage.....	66
Figure 15: Average Risk Rank of <i>Co-Creator</i> Solutions.....	67
Figure 16: Camera Distracts Players.....	74
Figure 17: (a) Player's Initial Position (b) Player's Final Position.....	75
Figure 18: Question 38 Likert-Type Responses.....	88
Figure 19: Question 39 Likert-Type Responses.....	89
Figure 20: Question 40 Likert-Type Responses.....	90
Figure 21: Question 41 Likert-Type Responses.....	91
Figure 22: Question 42 Likert-Type Responses.....	92

LIST OF TABLES

List of Tables

Table 1: Pilot Test Resource Fraction Summary	64
Table 2: Pilot Test Riskiness of Groups' Solutions and Scores	67
Table 3: Risk Score, Resource Fraction, Delay, Game Score Results.....	82
Table 4: Questionnaire: Likert Scale for WPI Students Results	87
Table 5: "Blended" Likert-Type Median & Mode	93
Table 6: Non-Blended Likert-Type Median & Mode	93

Executive Summary

BLENDING CHANGE NAVIGATOR

Digital technology, such as smartphones and tablets, have allowed board game developers to compete with the burgeoning video game industry by creating a new type of game that integrates both physical and digital elements (Kulšinskas, Artūras, Bālan, Bukdahl, & Brooks, 2015). These digitally augmented board games are known as blended, or hybrid games. Digital augmentation of board games can enhance the level of engagement, entertainment, usability, and flexibility of a game while preserving the social interaction associated with play around a physical board (Al Mahmud, Mubin, Shahid, & Martens, 2008; De Boer & Lamers, 2004).

Change Navigator is a business board game produced by Gametools that simulates the process of implementing change in the workplace. Gametools is in the process of adding digital elements, which will be used to track and store players' moves, into *Change Navigator* to make their game more customizable and less complex. This would also allow companies to use *Change Navigator* as an assessment tool. However, Gametools is concerned that surveillance through the addition of data handling into the game will impact players' willingness to experiment and take risks during gameplay. This is an issue because the primary purpose of using business games as training tools is to enable managers and executives to practice making decisions without risking real-life business operations (Jackson, 1959).

Many studies demonstrate that people's behavior changes significantly when they perceive that they are being watched, tracked, or assessed. For instance, Edward Diener and colleagues (1976) found that children who were being watched were far less likely to transgress than those who were not being watched. Based on this study and numerous others, it is reasonable to suspect that the element of surveillance introduced in the blended version of *Change Navigator* may alter play. Therefore, we hypothesized that the addition of

EXECUTIVE SUMMARY

surveillance in educational business board games would detract from a player's ability to make risky decisions.

ASSESSING THE IMPACTS OF SURVEILLANCE

Gametools wants to ensure that integrating digital technology into *Change Navigator* is not detrimental to the value of the game before producing the blended product (De Boer & Lamers, 2004). Therefore, our goal was to assess how the addition of surveillance to a physical board game, through tracking and data collection of players' moves, impacts players' behavior, game decisions, personal experience, and social interactions. To accomplish this, we set forth the following two objectives:

1. Develop and pilot test potential methods of assessing players' behavior, decision-making processes, social interactions, and personal gaming experience while playing both blended and non-blended board games.
2. Model how to assess the effects of surveillance on player's behavior, decision-making processes, social interaction, and personal gaming experience while playing blended games using both pilot tests and generated random mock gameplay data.

PILOT TESTING AND MODELING OUR METHODS

After reviewing numerous studies with goals similar to ours, we combined three frequently used methods--video observations, questionnaires, and group interviews--to pilot test on a convenience sample of 20 university students from Worcester Polytechnic Institute (WPI). We then revised our method and conducted an additional pilot test on a convenience sample of 10 Danish university students and business professionals.

Since playing *Change Navigator* is extremely time-consuming and the blended prototype had not yet been produced, we pilot tested our method using a similar game created by Gametools called *Co-Creator*. *Co-Creator* is a business game about innovation in

EXECUTIVE SUMMARY

the public sector, which contains game mechanics closely resembling those of Change Navigator, while requiring significantly less time to play. Participants were filmed as they played two different configurations of *Co-Creator*, simulating the non-blended and blended versions of the game. To simulate surveillance created by a blended game, we made the recorded footage visible to the “blended” pilot test groups as they played, similar to a mirror. For the non-blended version, our computers displayed a nondescript desktop background while filming to minimize the impacts of surveillance.

During filming, we recorded teams’ decisions because each action that the players’ collectively take is associated with a particular level of perceived risk. In particular, we assessed the riskiness of solutions selected by each group and the fraction of resources they were willing to spend relative to the number of resources available. Then, players responded to a questionnaire based on the Game Experience Questionnaire (GEQ) and Social Presence in Gaming Questionnaire (SPGQ) and adapted for *Co-Creator*. The questionnaire evaluated players’ level of enjoyment, immersion in the game, and social interactions. Last, players responded as a group to interview questions regarding their enjoyment playing *Co-Creator* and the impacts of the camera’s presence on their actions. By comparing this data between the non-blended and “blended” versions of the game, we were able to assess whether surveillance impacts players’ behavior and experience. Pilot testing our method also allowed us to determine if our methods for filming, interviewing, and data collection were logistically feasible and yielded useful data.

The purpose of the second objective was to demonstrate how to use and interpret the results of the methods developed in Objective 1. Due to a lack of participants, we were not able to collect enough data to perform a statistical analysis. Therefore, we generated 24 simulated games of *Co-Creator*, 12 for the “blended” version and 12 for the non-blended version, to model how to use the proposed statistical tests. For certain aspects of our methods, we used the data collected during the pilot tests and recommendations from

EXECUTIVE SUMMARY

Gametools to provide information that is more representative of human variation. We then described how to interpret the results of statistical analysis to determine whether or not adding digital elements to educational board games impacted players' actions and experience.

RESULTS OF A FEASIBLE METHOD

Implications of a Small Sample Size

There were not enough participants to determine any statistically significant correlations between surveillance and behavior; many of our results are inconclusive. However, the results of the pilot tests still provide useful information to Gametools for marketing purposes.

Video Observations

By reviewing video footage of gameplay, we were able to record all choices made during play of *Co-Creator*. For each test group, we calculated the average number of each resource required to implement a solution relative to the resources available. A higher average resource fraction indicates riskier decision-making because groups are willing to risk expending all of one resource rather than save resources for later stages in the game. We also recorded the number of delays voluntarily taken to pay for a solution or to replace a resource because accumulating upwards of three delays may adversely affect the team's score. As few teams understood how to correctly use delay cards, analyzing the number of voluntary delays may misrepresent the riskiness of teams' actions.

Despite knowing the outcomes of each solution, groups did not seem to take this into account when ranking the riskiness of each solution after the interview. We decided that it was more appropriate to have groups rather than individuals perform the risk-ranking because the group selects the solutions during gameplay. From these rankings, we calculated an average risk for each solution between 1 and 3 (1-least risky to 3-most risky). Based on the risk score associated with each solution, we calculated an average risk of all the solutions

EXECUTIVE SUMMARY

selected by a group. Interestingly, we identified a possible correlation between final game score and the average riskiness of solutions. Final game score increased as the average riskiness of a group's selected solutions increased.

Questionnaire

The questionnaire provided useful and quantifiable data. We successfully, statistically analyzed the Likert scale questions using the "F-Test Two-Sample for Variances" and "Two-Sample Assuming Equal Variances t-Test." We also examined the Likert-type items using frequency, mode, and median. The questionnaire results indicated that none of the Likert groups were significantly different between the non-blended and "blended" versions for the first pilot test. This means that the WPI students playing the "blended" version and the non-blended version did not have differing responses about social interactions, personal experiences, and overall gameplay experiences for each of the Likert groups.

Interviews

There was not an apparent distinction in the level of enjoyment between the non-blended and "blended" versions. The first four groups indicated that they agreed with the decisions made during play. Members of the final two groups stated that while they did not always agree with the decisions made, they agreed with the democratic process used to select solutions -- as long as everyone had the opportunity to voice an opinion.

Five groups reported that they were comfortable playing with the other players. This was expected because the participants were well-acquainted classmates. Despite being strangers, the final group felt comfortable with their group members. Therefore, players' comfort-level with fellow players did not impact players' willingness to suggest riskier solutions.

Three out of four groups of the first round indicated that the camera was distracting during gameplay. For both the "blended" and non-blended groups, players looked directly at,

EXECUTIVE SUMMARY

or spoke to the camera. In the “blended” groups, players indicated that because they were able to see themselves while being recorded, they were self-conscious about their appearance. Several groups also indicated that the camera may have been more distracting if someone other than their peers reviewed the footage. These results suggest that our study may be biased because groups playing both the non-blended and “blended” versions of *Co-Creator* were influenced by the presence of the video camera. In the second round of pilot tests, both the non-blended and “blended” group unanimously agreed that the camera was not distracting and that they were too involved in the game to notice its presence. There may be a discrepancy between players’ perception of how the camera impacts their actions and the actual impacts of surveillance.

Although three groups stated that the camera impacted their comfort-level and caused distraction, all groups indicated that the camera did not impact the decisions they made. This could either indicate that players simply perceived that their actions were not impacted by surveillance, or that our “blended” set-up does not accurately simulate a blended version of *Co-Creator*. Furthermore, several players suggested that if a figure of authority such as their employer, an employee of Gametools, or a professor reviewed the footage, they would care more about the choices made during the game.

FUTURE IMPLEMENTATION OF OUR METHOD

The most important aspect of what we accomplished was a method to track the differences between a “blended” and non-blended educational business board game, more specifically, those designed by Gametools. We also developed and tested a statistical method to ascertain if there is a significant difference between the two different versions. We hypothesized that the addition of surveillance in educational business board games would detract from a player’s ability to make risky decisions. While this project did not receive enough participants to statistically suggest whether or not the hypothesis was supported, it

EXECUTIVE SUMMARY

did set the groundwork to continue testing and eventually determine if the hypothesis is supported.

The questionnaire provided the strongest evidence that integrating digital technology into business board games will not have an impact on personal experience, social interactions, and overall gameplay experience. Anecdotal information collected during our interviews also suggested that our hypothesis was incorrect; surveillance in business board games is seemingly inconsequential. *However, what people say they feel and contend that they would do does not always align with what they actually do.* This may explain why, even though all groups reported that the presence of the camera did not impact their decisions, the data collected from our video observations supported our hypothesis.

Groups consistently reported that had someone with greater authority reviewed footage of play, their decisions may have been impacted. *Therefore, the making of the blended game itself does not impact how players experience and play the game, but the context of the game- how the facilitator frames the game and who is reviewing the data collected – is extremely influential on player’s behavior.* This result would be beneficial to Gametools because it suggests that creating a blended version of *Change Navigator* would not inherently have a detrimental effect on the value of the game.

When Gametools implements our method to compare the original non-blended and blended prototype version of *Change Navigator*, we recommend the following:

1. The facilitator and person reviewing gameplay data should be a figure of authority.
2. Create a pretense that the game results will be used to assess players’ skills.
3. Test on players of an older generation.
4. If performing the study using *Change Navigator*, allow players to play one or two rounds instead of all three. This reduces the time commitment, making it easier to recruit a larger pool of participants.
5. Begin recruiting universities, companies, and participants early and aggressively.

EXECUTIVE SUMMARY

6. Eliminate the statements in the questionnaire that caused confusion and then revalidate the Likert scale with a large enough sample size.
7. Use a blended prototype of *Change Navigator* to conduct the study.

Abstract

Gametools wished to understand the impact of surveillance on participants playing business board games. Our team used video observations, questionnaires, and group interviews to collect, analyze, and compare players' experience and behavior while playing blended and non-blended board games. The data collected through questionnaires and interviews indicates that surveillance caused by blending business board games does not impact player behavior, social interaction, experience, or decisions. Rather, it is who analyzes the data collected that impacts players the most.

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Introduction

Advancements in digital technology have revolutionized how we communicate, travel, work, and even how we play. Video games, in particular, have grown increasingly popular over the past three decades. Despite this growing popularity, simple board games remain popular, both as entertainment and as an effective training tool. The Game Manufacturers Association estimated that the global sale of non-electronic specialty games (which exclude bestselling standbys like Trivial Pursuit, Scrabble and Connect Four) rose from \$700 million in 1995 to \$2.7 billion in 2003 (Barbaro, 2003). This rise in sales is particularly strong for complex strategy games, such as *Chess*, in both the US and Europe (Barbaro, 2003). Despite the rising sales of board games, manufacturers of these games continually search for ways to compete with the rising popularity of video games, a \$61 billion industry worldwide in 2015 (De Boer & Lamers, 2004; Superdata 2016).

Digital technology, such as smartphones and tablets, have allowed board game developers to compete with the video game industry by creating a new type of game that integrates both physical and digital elements (Kulšinskas, Artūras, Bālan, Bukdahl, & Brooks, 2015). These digitally augmented board games are known as blended, or hybrid games. Digital augmentation of board games can enhance the level of engagement, entertainment, usability, and flexibility of a game while preserving the social interaction associated with play around a physical board (Al Mahmud, Mubin, Shahid, & Martens, 2008; De Boer & Lamers, 2004). According to de Boer (2004), digital technology can be used to “fill holes in the game concept, that cannot be filled using traditional manners” such as the “simulation of additional players, randomly changing game board composition, automatic error detection and prevention, and integrated digital game rules” (p. 5).

Change Navigator is a business board game produced by the Danish company Gametools that simulates the process of implementing change in the workplace. The three-to-

INTRODUCTION

six player cooperative board game allows players to experience the obstacles associated with enacting change in a company and identifies possible solutions to overcome these challenges. Gametools is in the process of blending digital elements into *Change Navigator* to make their game more customizable and less complex. More importantly, the addition of digital elements that track and store players' moves would allow companies to use *Change Navigator* to assess the strengths and weaknesses of management and predict the direction of their company. Gametools' Director, Povl Gad, believes this to be a major selling feature of the blended product. However, Gametools is concerned that surveillance through the addition of data handling into the game will impact players' willingness to experiment and take risks during gameplay. This is an issue because the primary purpose of using business games as training tools is to enable managers and executives to practice making decisions without risking real-life business operations (Jackson, 1959). Consequently, players can experiment with "riskier" actions that they may not otherwise take in real-life. Povl Gad argues that such experimentation is what allows players to maximize the knowledge gained through playing the game.

Considerable research has compared people's experience playing traditional and digitally augmented board games. Kulšinskas and colleagues (2015) concluded that digital augmentation of board games does not significantly impact social interaction and made play easier because the computer kept track of the rules. Both Erb (2015) and Kulšinskas and colleagues' (2015) studies reported that digital, step-by-step instruction manuals can improve the speed at which players learn the game and encourage people to actually read the instructions. Ip and Cooperstock (2011) found that when players rated a fully physical, a fully digital, and a blended version of *Settlers of Catan* based on usability, aesthetics, focused attention, sensory and image immersion, and positive social interactions, they consistently rated the blended version the highest. However, there are concerns that the element of surveillance involved in the blended version of *Change Navigator* may alter play. Many studies

INTRODUCTION

demonstrate that people's behavior changes significantly when they perceive that they are being watched, tracked, or assessed. Edward Diener and colleagues (1976) identified a relationship between the illusion of being watched and people's behavior during their study of 1300 trick-or-treaters. When instructed to take one piece of candy, children who had disclosed personal information (and therefore were no longer anonymous) were far less likely to take multiple pieces of candy than children who did not. Beaman and colleagues (1979) also demonstrated that when children observed themselves taking candy in a mirror, they were less likely to take multiple pieces of candy when instructed to take only one. Therefore, we hypothesized that the addition of surveillance in educational business board games would detract from a player's ability to make risky decisions.

Due to the novelty of blended business games, little-to-no research has been performed on how surveillance through the addition of digital elements to a business board game affects players' actions. Therefore, our goal was to assess how the addition of surveillance to a physical board game, through tracking and data collection of players' moves, impacts players' behavior, game decisions, personal experience, and social interactions. To accomplish this, we developed and iteratively refined a method of assessing and comparing players' actions while playing the non-blended and blended versions of Gametools' business games. Since playing *Change Navigator* is extremely time-consuming and the blended prototype had not yet been produced, we pilot tested our method using a similar game produced by Gametools called *Co-Creator*. *Co-Creator* is a business game about innovation in the public sector, which contains game mechanics that closely resemble those of *Change Navigator* while requiring less time to play. After pilot testing, due to a lack of participants in our study, we created a computer program that generated random mock data of *Co-Creator* gameplay to model how to analyze and interpret the data collected using our method.

In the near future, Gametools will implement our method to compare the original non-blended and blended prototype version of *Change Navigator*. Relative to traditional board

INTRODUCTION

games, the development and production of electronically augmented products is costly (De Boer & Lamers, 2004). Therefore, Gametools wants to ensure that integrating digital technology into *Change Navigator* is not detrimental to the value of the game as a business training tool before producing the blended product.

Background

BUSINESS GAMES: PLAY IN A RISK-FREE ENVIRONMENT

In recent years, educational games have become more and more prevalent. Unlike traditional board games, such as *Monopoly*, educational games are primarily designed to teach and develop skills (Andlinger, 1958; Jackson, 1959). Although educational games are often fun to play, the purpose of playing educational games is not necessarily to win, but to learn from the experience and apply that knowledge in the real world (Andlinger, 1958). As a result, the outcome of an educational game typically relies more heavily on a player's experiences, skill, and judgment as opposed to luck (Andlinger, 1958). *Change Navigator* is an educational game that simulates management's decision-making processes and enables players to recognize the consequences of management's decisions. This type of educational game is known as a business game.

Business games were developed in the late 1950s to provide an opportunity for employees to practice decision-making and consider new approaches without risking real business operations (Jackson, 1959). Business games are the direct descendants of complex war games used during World War II (Jackson, 1959). These war games dealt not only with battle strategies and war tactics, but also with logistical problems such as supply chains and industrial support (Jackson, 1959). War games enabled military personnel to hone their skills, develop new knowledge, or consider new strategies without risking lives or resources. The remarkable success of *Monopologs*, a war game developed in 1955 to simulate the U.S. Air Force supply system, fostered the creation and implementation of business games (Jackson, 1959). Upon returning home, military officers who were taught through war games like *Monopologs* applied this training method to civilian businesses (Keys, 1990).

The rise of business games was also spurred by the development of David Kolb's Experiential Learning Theory (1984) (Keys, 1990). The premise of Kolb's theory is that concrete

BACKGROUND

experiences are translated through observation and reflection into abstract concepts. This abstracted knowledge can be applied to similar scenarios that someone would experience in real-life (Lawrence & Hutchinson, 2011). Using this theory, business games simulate years of real-life business operations in a matter of hours (Andlinger, 1958).

USING BUSINESS GAMES TO ADDRESS CHANGE IN THE WORKPLACE

One variety of business games allows management to consider approaches to implementing change in the workplace. Business games addressing change in the workplace simulate the challenges that organizational management often faces when trying to find appropriate approaches to implement and monitor change. These games also demonstrate the difficulties employees face when adjusting to change (Laframboise, Nelson, & Schmaltz, 2002). Although change may be difficult, it should not be assumed that employees are necessarily against change. Rather, individuals often struggle to cope with the newness of the situation (Laframboise et al., 2002). Differing feelings and characteristics affect how employees perceive change such as “attitudes and beliefs, educational and professional backgrounds, age group, organizational positions and professional roles” (Hetzner, Heid, & Gruber, 2015, p. 35). Laframboise, Nelson, and Schmaltz (2002) identify three categories of employees with regards to their reactions to change in the workplace: the “OH!” group, who is unsure about change, the “GO!” group, who embrace change, and the “NO!” group, who “see[s] change as a threat and will resist” (p. 308). According to Laframboise and colleagues (2002), one of the biggest obstacles to implementing change stems from preventing members of the “NO!” from influencing the opinions of those in the “OH!” group. One strategy to overcome this obstacle is to use the positive “GO!” group to sway the minds of the unsure group. Through simulating the interactions between these three groups, business games teach players strategies for using the different reactions to change to their advantage such as harnessing the positivity of the “GO!” group.

BACKGROUND

When enacting changes, management must pre-determine how and when to address employees and how to engage employees in the process of change. In addressing employees about change, a communication plan is imperative to “outline when, where, and how” (Laframboise et al., 2002, p. 309) to deliver such information. It is equally important to continually update employees throughout the change process so that they feel involved. To enhance employee cooperation, management can use strategies such as “town hall meetings” where the employees can hear management’s plans and express grievances, involve their employees in the changes, and post-occupancy evaluations in the case of office relocation (Laframboise et al., 2002). Business games present such strategies of conveying information about change to employees and simulate employees’ responses to these methods.

Business games provide not only strategies, but also practice in performing such actions in a sensitive and successful manner. By working through the real-life scenarios that the games offer, participants can develop novel ideas that aid in constructing a better managed, more informed, workplace. Through trial-and-error, players can experience different approaches to implementing change and how these approaches might affect the dynamics between employees.

A CHANGE-FOCUSED BUSINESS GAME: *CHANGE NAVIGATOR*

Change Navigator is a business game produced by the Danish company, Gametools, which simulates the challenges associated with implementing change in the workplace and identifies possible strategies to overcome these obstacles. *Change Navigator* is a three-to-six-player physical board game in which players are provided a scenario that describes the background of a fictitious company and how that company needs to change. Based on this scenario, participants work as one team to discuss and assess how change may impact various elements of the company as shown in Figure 1a. After consensus is reached, the facilitator compares the players’ assessment to that of a professional to determine how well the

BACKGROUND

participants' analyzed the situation. If the players make a successful prediction, they are rewarded with change fuel chips (Figure 1b) that determine the number of actions they can make.

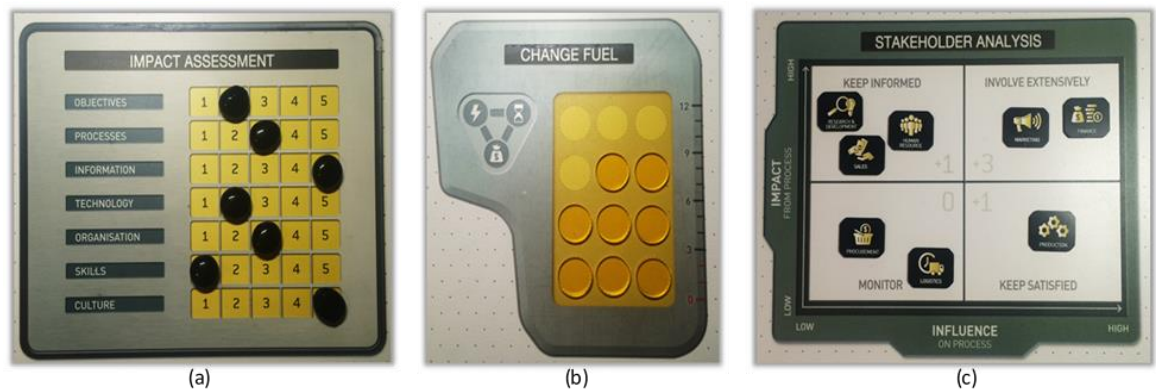


Figure 1: (a) *Change Navigator* Impact Assessment (b) *Change Navigator* Change Fuel (c) *Change Navigator* Stakeholder Analysis

Players must then decide how much each division of the company will influence and be impacted by the change shown above in Figure 1c. Once again, the facilitator compares the players' prediction to a professional's report and awards change fuel chips for proper analysis. Next, the facilitator describes the initial attitudes of each stakeholder towards the change. This is physically represented by placing game pieces of the different divisions into one of four different sections labeled "no-," "no+," "yes-," and "yes+." These four categories, shown in Figure 2a, represent the attitudes of the individual stakeholders based on the research of a Swedish change theorist named Claes Janssen (Gad P. Personal communication, 2016). These categories are very similar to the "OH!," "NO!," and "GO!" groups developed by Laframboise and colleagues (2002).

BACKGROUND



Figure 2: (a) *Change Navigator* Change Attitude (b) *Change Navigator* Leadership Actions

The players then select four cards from a deck of action cards. Each card describes a strategy that could be used by management to encourage employees to respond positively to the change. The action cards only impact certain divisions based where players place the limited number of change fuel chips that they possess, which is shown in Figure 2b. Consequently, when players earn more change fuel chips, they can impact more divisions with the action cards. Depending on the current attitude of each division, the actions have differing effects. Through this, the players learn how management's decisions impact their ability to raise the morale of different stakeholders. The goal is to encourage as many stakeholders as possible to be amenable to change through strategic planning and use of actions cards.

IMPROVING *CHANGE NAVIGATOR*

The existing version of *Change Navigator* is a physical board game containing no electronic elements. However, Gametools is in the preliminary stages of creating a new game platform for *Change Navigator* that integrates technology with physical components. The company plans to add a video camera, or radar device, to keep track of all moves players make. Gametools also plans to replace the instructions with a tablet to create a blended

BACKGROUND

game. Blended, or hybrid games, are digitally augmented board games that combine the best attributes of both physical and digital games.

Gametools wants to add digital elements to *Change Navigator* for several reasons. The addition of data mining would enable companies to use *Change Navigator* as a tool to assess the strengths and weaknesses of their management. By storing gameplay data, a company could track their management's improvement from game-to-game over time. By comparing data collected in the game to other companies' game data, *Change Navigator* could also be used to project the direction of a company. Gametools Director, Povl Gad, stated that this information alone could be a major selling point. Other benefits Gametools would like to see from digital augmentation include: greater adaptability, easier scalability, hidden complexity, and perceived simplicity.

These benefits of digital augmentation address limitations of the existing, non-blended, version of *Change Navigator*. To tailor the game to specific clients, the current version of the game must be reprinted, which is costly. Through digitization, the company could provide several-digitally stored scenarios without having to reproduce the physical components each time. Scalability is another problem for the current game, because there is limited space for social interaction around the existing game board. To solve this problem, Gametools has suggested the use of tablets to allow a much larger number of participants than the existing limit of three to six players. Hiding complex game mechanics and game pieces that are not needed during a particular stage of the game will make the game appear simpler. For example, the digitization of action cards would allow used cards to be removed in sequential rounds, preventing players from becoming confused by the availability of cards that they cannot use (Gad P., personal communication, 2016). However, while *Change Navigator*'s blended version will address issues concerning varying scenarios, scalability, and hiding complex game mechanics, the surveillance incorporated into the blended version may cause adverse effects or unanticipated behaviors during gameplay.

BACKGROUND

CO-CREATOR

Currently, the prototype for *Change Navigator* has not yet been developed. However, Gametools previously made a similar board game called *Co-Creator*. The purpose of *Co-Creator* is to spur innovation in the public sector. As one of Gametools first products, *Co-Creator* has been extensively tested and used by hundreds of businesses. Despite some differences in content, both *Co-Creator* and *Change Navigator* follow a similar premise of decision making, risk and reward, and strategy. In *Co-Creator*, one group of 4-6 players is given an initial scenario about producing an innovative product and work collectively to complete the project given. The players' success is measured through three parameters: innovative culture, innovative solutions, and goal attainment (Figure 3).

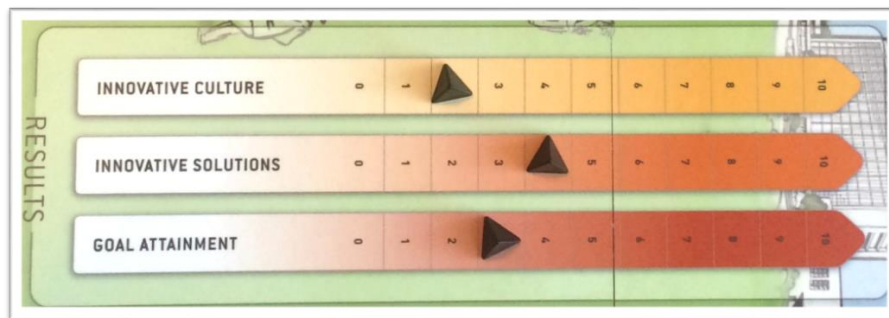


Figure 3: *Co-Creator* Success Parameters

To begin, players select four stakeholders that they will use throughout the project. It is imperative that these stakeholders are diverse because each one supplies the players with varying number and types of resources (Figure 4a) at three of seven stages in the game: Initiator, Facilitator, and Catalyst. As players proceed through the stages of the project, they encounter challenges (Figure 4b). Each challenge is accompanied by three different solutions (Figure 4b), one of which the players must carefully select.

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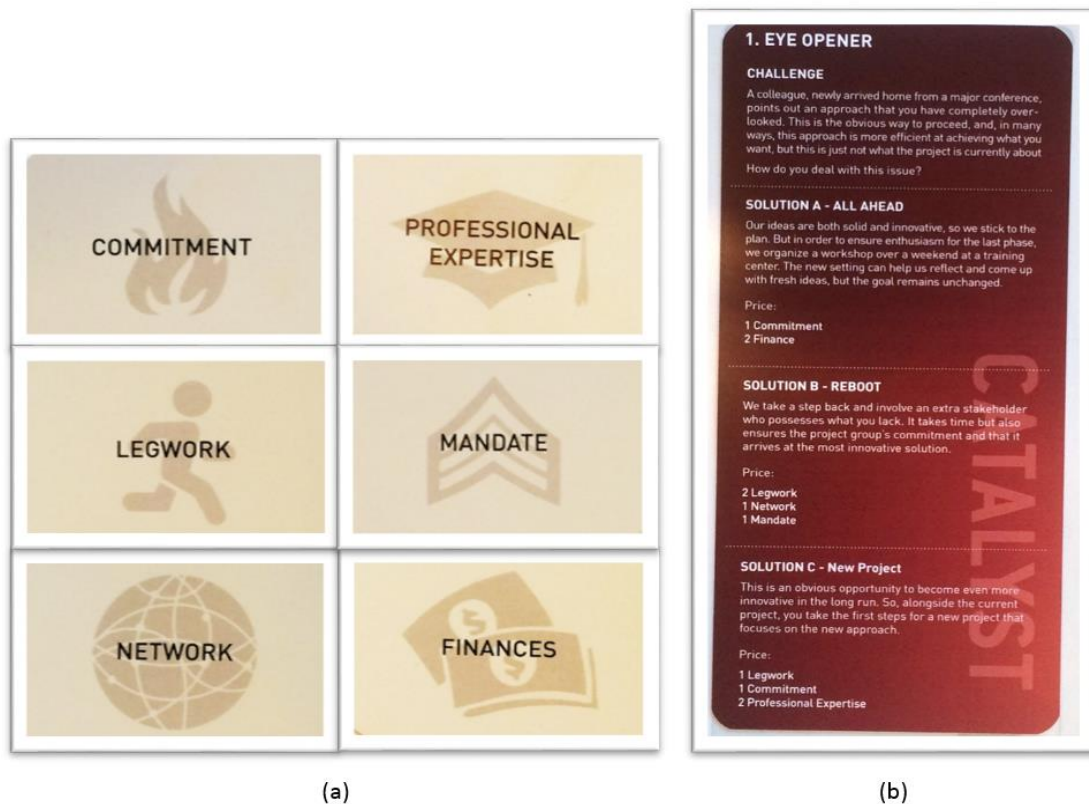


Figure 4: (a) Co-Creator Challenge and Solutions (b) Co-Creator Resource Cards

Each solution costs a finite amount of resources; some solutions are most costly than others. Therefore, players must weigh the expected benefit of the solution against its price and other potential consequences. Similar to Change Navigator, the solutions can be categorized into different levels of riskiness. After players choose a solution, the benefits and repercussions of the solution are revealed. These benefits are reflected by an increase in the success parameter scores and a positive reallocation of resources. The consequences of their choices are reflected through a reduction in success parameter scores or a loss of resources. The goal of the *Co-Creator* is to achieve as high an average innovative culture, innovative solution, and goal attainment scores as possible.

BACKGROUND

CHARACTERISTICS TO CONSIDER IN DESIGNING BUSINESS GAMES

When designing a successful business game, like *Change Navigator* or *Co-Creator*, it is important to take into account several aspects of the game. These design aspects include: learning styles, game complexity, degree of abstraction, and how the facilitator administers the game (Keys, 1990).

Learning style significantly influences how players obtain knowledge through a game (Dunwell et al., 2011). The two main learning styles are intuitive and sensing learners. Intuitive learners “build their own conceptual models and grasp general concepts through abstraction or imagination” (Dunwell et al., 2011, p. 831). Intuitive learners search for “patterns and meaning—principles and theories” (Cook, Thompson, Thomas, & Thomas, 2009, p. 80). On the other hand, sensing learners focus on facts and data. Sensing learners’ “process-based approach” requires more structure, less abstraction, and a greater need for exactness when learning (Dunwell et al., 2011, p. 831). For these reasons, it is difficult to create game-based learning tools for sensing learners (Dunwell et al., 2011). Game-based learning typically favors intuitive learning styles because they are able to “reflect on their experiences and transfer them outside of the direct context of learning” (Dunwell et al., 2011, p. 831). However, games can and should appeal to sensing learners if they are to be effective, particularly in addressing the complexities of the work place. *Change Navigator* appeals to both types of learners. The game offers intuitive learners the opportunity to reflect on the actions taken and how different decisions could be improved to result in better, alternative outcomes. On the other hand, the game allows sensing learners to work through scenarios as a process to understand the best strategy for management during a time of change.

The second design element, creating real-life complex scenarios, is particularly challenging because the game must be both realistic and simple enough to play. Balancing “realism and playability” (Andlinger, 1958, p. 117) is crucial to management games because “the closer a game resembles reality, the more cumbersome it becomes” (Andlinger, 1958, p.

BACKGROUND

117). Business games must be simple enough to provide an “accelerated frame of action” (Keys, 1990, p. 308) but, if they become too abstracted they will not induce responses that mimic real-life scenarios (Andlinger, 1958). Business games must also be “partly deterministic and partly probabilistic” (Andlinger, 1958, p. 117) because many real-life outcomes are subject to probability or chance (Andlinger, 1958). These random elements cannot be too extreme as players need a sense of control to avoid attributing their success or failure to luck. In the case of Change Navigator, the player is presented a scenario about change in the workplace that is realistic. The game creates chance by allowing the player to choose an action card or business decision without the knowledge of the full impact it will have on the organization. Additionally, unexpected events such as “production woes” occur, which cause game pieces to move without the players’ control during the game.

Even when a management game is fairly realistic, the player will recognize that because the experience is a game, the scenario is not real. To counteract this perceived unreality, the game must have a facilitator, who is skilled at “extracting real learning from artificial situations” (Lawrence & Hutchinson, 2011, p. 4). In addition, if learning is not discussed and analyzed, much of the experience’s value is lost (Lawrence & Hutchinson, 2011, p. 4). Therefore, it is important for a facilitator to encourage participants to reflect on what they did well and what they should have done differently. *Change Navigator* employs a facilitator to lead gameplay. The facilitator is either an employee of Gametools’ or an employee of the company playing Change Navigator. Prior to leading the game, the facilitator receives at least six hours of facilitator training to enable them to fully explain the components of the game and lead reflective discussions throughout and after the game. Overall, the facilitator's role is to surveil over the game and give feedback and assistance during gameplay.

BACKGROUND

BLENDING PHYSICAL BOARD GAMES WITH DIGITAL TECHNOLOGY

Even when business games appeal to both intuitive and sensing learning styles, balance realism and playability, and employ a facilitator, there are a few disadvantages to using management games in the workplace. Some games, like Change Navigator, have extensive instructions that are time-consuming to learn and can make the game cumbersome and inconvenient to use (Keys, 1990). This detriment is often compounded when users attempt to learn and play the game without initially reading the instructions. Even if the instructions are read thoroughly, players will still have to overcome a learning curve. This occurs when the rules have been presented, but the optimal gameplay is unclear until further play has been completed. Translating the abstract ideas learned through gameplay and applying those concepts to reality can also be a challenging task. Lastly, playing business games can also be a counterproductive training tool because the player could learn a detrimental skill just to win the game, which cannot be applied to the real-world (Dunwell et al., 2011). Dunwell and colleagues (2011) at the Serious Games Institute of Coventry University question, “what stops a learner who discovers trial and error to be an effective way of ‘beating’ the game to attempt trial and error when faced with a real-world situation?” (pp. 831-832). Dunwell and colleagues’ (2011) theory relies on the “learner to recognize the difference between game and real-world situation” (pp. 831-832).

While some of the disadvantages of using business games, which are traditionally physical games, cannot be avoided, some can be improved by the use of digital technology. For example, using a digital instruction manual that gives step-by-step instructions during gameplay can make learning the game easier and encourage people to actually read the instructions. Kulšinskas and colleagues (2015) found that several participants indicated that the digital version was easier to use because the computer kept track of the rules. Similarly, in Erb’s (2015) study players also reported that it was much easier and quicker to learn the rules of play through an interactive tutorial than figuring out how to play the physical version.

BACKGROUND

Players reported that this was because they were far more motivated and comfortable using the digital version (Erb, 2015).

However, business games should not be made entirely digital either. A recent study examined differences in gamers' experience as they played the physical and digital version of KEEP COOL, a simulation game where up to six players negotiate against each other about climate protection (Erb, 2015). Contrary to the authors' expectations, the digital game "was perceived by players to be more complicated than the analog version and, consequently, was less effective at facilitating learning and attitude change" (Erb, 2015, p. 818). This surprising result was due to differences in how players communicate between the two versions. Face-to-face communication was an asset for the physical board game. The ability to discuss their moves and roles in-person helped players stay engaged and increased player understanding. In the study, it was observed that "[people] who played the digital game via iPads and who were initially placed in different corners of the same room, came together after a while and put their chairs in a circle, so that they could communicate face-to-face" (Erb, 2015, p. 832). Physical board games provide a better overall view of gameplay than the small screens of most digital gaming devices. This allows players to more easily contextualize the information provided to them (Erb, 2015). Digital games often use their interface to hide game mechanics such as the exchange of pawns or tokens. Although this may simplify the game, it hides certain cause-effect mechanisms from the players. As noted by Erb (2015), "for a simulation game it is important that players can experience the consequences of their actions intuitively" (p. 46) through moving pawns, shuffling cards, and rolling dice.

The results of these studies suggest that successful business games should retain a physical game as its foundation to maintain important face-to-face communication. On the other hand, the addition of certain digital elements could be used to make the game easier, clearer, more streamlined, and faster to play. Such digitally augmented games are known as blended games. Kulšinskas and colleagues (2015) concluded that, unlike in fully digital games,

BACKGROUND

the digital augmentation of board games does not significantly impact social interaction. The authors note that, if integrated in an appropriate manner, players should be able to understand the feelings and thoughts of one another during gameplay. In their assessment, digitizing the game had no significant effect on empathy, negative feelings, or behavioral engagement.

The addition of data-handling capabilities in blended games further enhances the experience of playing board games in several ways. Digital elements can replace tedious tasks such as calculations and trading mechanics. Digitized game pieces can also be used to interpret circumstantial information, store data, communicate with each other, track players' actions, and even determine the skill level of each player (Mandryk & Maranan, 2002). According to a study performed by Kulšinskas and colleagues (2015), there exists a trade-off between providing tangibles that enable the player to "literally grasp data with their hands" (p. 485) and the portability of the game. Blended games exploit the balance of this trade-off. Ip and Cooperstock (2011) found that players preferred the blended version of *Settlers of Catan* over the digital and physical versions of the game because "players found tangible components essential for negotiation and resource trading," but "preferred automatic, organized board setup" (p. 454). Possibly the greatest advantage of blended educational games is the availability of both immediate feedback and long-term feedback (Dunwell et al., 2011). In the case of Change Navigator, immediate feedback could be given through the use of tablets that keep track of movements in the game, and long-term feedback would continue to be given through the facilitator at the end of the game.

In the blended version of Change Navigator, the addition of digital elements does not remove the interaction of players because the physical board game and face-to-face communication remain intact. The blended version will include tracking the player's' decisions and movements. However, the new surveillance associated with collecting data about players'

BACKGROUND

actions could greatly impact how players make decisions and reduce their ability to make risky decisions in the risk-free game environment.

IMPACTS OF SURVEILLANCE ON GAMEPLAY

Gametools is concerned that the addition of surveillance elements will impact players' actions and behaviors. Business games allow employees to develop management skills by experiencing the need for "coordination and balance in a business," (Andlinger, 1958, p. 125) long-range plans, objectives, and effective organization to deal with time-sensitive problems. Players learn these skills by practicing taking risks and making decisions with incomplete knowledge (Andlinger, 1958). Therefore, the purpose of using games like *Change Navigator* as training tools is to enable players to practice making decisions without risking real-life business operations. Players can experiment with "riskier" actions that they might not otherwise take in real-life scenarios. Gametools hypothesizes that when players perceive that they are being watched or assessed through the tracking of their moves, they may be less willing to experiment with such actions.

Several studies demonstrate a correlation between anonymity and poor behavior. For example, Ernest-Jones and colleagues (2011) led a small group of scientists from Newcastle University in conducting an experiment on how the illusion of being watched can significantly change a person's behavior. The 32-day study revolved around a poster with human eyes and the littering behavior of students in a cafeteria. The scientists hung posters around the cafeteria, which either had eyes without corresponding text, eyes with corresponding text, or no eyes at all. The corresponding text would say something along the lines of please place your tray in the racks after you have finished eating. Also, the posters were hung up in randomly determined areas around the cafeteria, but they were always hung at eye level. The study demonstrated a correlation between the amount of littering in an area and the illusion of being watched by human eyes. The study showed that, compared to the posters with

BACKGROUND

flowers, the posters that had eyes resulted in twice as many people cleaning up after themselves (Ernest-Jones, Nettle, & Bateson, 2011).

Furthermore, several other researchers have identified a possible correlation between the illusion of being watched and behavior. For example, Diener and colleagues (1976) conducted an experiment to understand the relationship between deindividuation and stealing candy on Halloween. The naturalistic study unobtrusively observed upwards of 1,300 trick-or-treaters after they were instructed to take one piece of candy. This study determined that when trick-or-treaters were asked to identify themselves, they were less likely than anonymous children to steal (7.5% transgression compared to 21.4%; $P < 0.001$). In another variation of the study, the researchers discovered that children who were in groups were more likely to steal than those who were alone (20.8% transgression compared to 57.2%; $P < 0.001$) (Diener, Fraser, Beaman, & Kelem, 1976). A similar study on deindividuation and candy theft at Halloween by Beaman and colleagues (1979) demonstrated that when children watched themselves taking candy in a mirror, they were also less likely to steal (50% transgression without mirror, 25% transgression with mirror). These results suggest that any form of surveillance, even watching oneself, impacts a person's decision-making processes (Beaman, Klentz, Diener, & Svanum, 1979).

These studies indicate that there is a relationship between anonymity and the willingness to transgress. As a result, surveillance of gameplay may influence player's actions and willingness to experiment and take risks during play. In Change Navigator, players face risk when choosing action cards and determining the amount of change fuel chips to use. Therefore, it is important to evaluate changes in players' selection of game pieces among other behaviors to assess the impact of tracking and collected data on players' actions.

BACKGROUND

EVALUATING THE IMPACTS OF SURVEILLANCE ON GAMEPLAY

Several studies have evaluated the impacts of adding digital elements to board game on players' learning, decision-making processes, personal gaming experience, and social interaction. These studies use a variety of methods to compare user experience such as video observations, pre- and post-testing, questionnaires, interview, think aloud protocol, and heuristics.

Video Observations

When evaluating gaming experience, researchers often film gameplay for future analysis. Al Mahmud and colleagues (2008) filmed senior citizens playing a paper and augmented tabletop version of a game to qualitatively assess gaming experience. Due to the small sample size of eight players and minimal footage to review, researchers were able to qualitatively assess players' reception of the game by evaluating their actions such as assisting team members, opponents, moving game pieces, and gaze. Al Mahmud and colleagues (2008) also used players' recorded verbal communications to support their conclusions. Magerkurth and colleagues (2004) videotaped young girls as they interacted with several digitally augmented games in a formative evaluation. To determine how long it took the girls to learn how to play the games and to compare players' interactions using each games, the researchers analyzed footage of gameplay. Kulšinskas and colleagues (2015) also performed in-depth analysis of footage of 15 participants playing a traditional and hybrid version of a game. The five recorded gameplay sessions were analyzed using "interaction analysis while looking for elements related to social presence, specifically gaze, smiling, and personal topics of conversation" (Kulšinskas et al., 2015, p. 489) to triangulate the results of their interviews and questionnaires. Video analyses are time-consuming and typically produce qualitative results due to the small sample size.

BACKGROUND

However, many studies have used a set of metrics to quantify videotaped observations of gameplay. Seif El-Nasr and colleagues' (2010) study evaluating the cooperative nature of video games, used a set of validated pre-defined Cooperative Performance Metrics (CPMs) to analyze 3000 minutes of video data of 60 children playing cooperative games. These metrics include: laughter or excitement together, working out strategies, helping, global strategies, waiting for each other, and getting in each other's way. Each metric was associated with a set of observable events. While reviewing footage of gameplay, each event was annotated with the corresponding CPM. Similarly, Yan Xu (2011) qualitatively analyzed 262 minutes of videotaped gameplay of tabletop augmented reality game to discover commonalities among events and behaviors that represent the same type of social interaction in different ways. First, the researchers transcribed and summarized every event involving two or more players and recorded the associated social and physical behaviors of every player. These observable actions were then grouped by association into five categories to describe social events during gameplay: chores, reflection on gameplay, strategies, out-of-game, and game itself. These methods are time-consuming because it requires filming many participants and several interactions to create a reliable set of metrics (Xu, Barba, Radu, Gandy, & MacIntyre, 2011). These metrics must then be validated by inter-rater agreement methods (Xu et al., 2011).

Pretesting and Posttesting

Pretesting and posttesting are used to compare what a person knew before a learning scenario using a pretest and what he or she knew after by using a posttest. This method is used to "quantify the knowledge attained" from a group that has "diverse learning styles and educational backgrounds" (BU OME Faculty Development). A disadvantage of using this method is that it tests on questions that are focused on retaining and recalling information rather than an "improvement in performance" (BU OME Faculty Development). In most cases, the pretest and posttest are identical (Gray, Topping, & Carcary, 1998). Gray and colleagues (1998) used a pretest and posttest to compare alternative approaches to comprehending the

BACKGROUND

state's *Highway Code*, including the use of a board game. In the study, they pretested and posttested 64 fifteen and sixteen-year-olds and compared the mean score and standard deviation for the pretest and posttest (Gray et al., 1998). After reading a book version of the *Highway Code*, test scores increased from a mean of 13.86 to 21.25, whereas after playing the game version, test scores increased from a mean of 13.94 to 30.87 (Gray et al., 1998). The participants who played the board game had a much higher increase in their score, which suggests that games are effective learning tools. This provides an example of how pretesting and posttesting can be useful when comparing how much a person learned in an experience or game.

GEQ & SPGQ Questionnaires

The Social Presence in Gaming Questionnaire (SPGQ) measures the effects of social presence on the gamer. It creates “metrics for psychological involvement, measuring both empathy and negative feelings, and behavioral involvement with other person(s)” (Cowgill, Edgecombe, Ford, & Heather, 2007, p. 1). In a study by Cowgill and colleagues, they examined the 13 university students to see if the three categories measured in the SPGQ increased when players were under supervision or helped to use the game (Cowgill et al., 2007). They used the Mann-Whitney U test to test for statistically significant differences and found that empathy and negative feelings had no effect from the supervision, but behavioral involvement was affected by the supervisor (Cowgill et al., 2007). This provides an example of how the SPGQ can be used in studies on changing gameplay.

The Game Engagement Questionnaire (GEQ) measures the engagement of the player in video game-playing (Brockmyer et al., 2009). The GEQ uses a Likert scale to measure immersion, presence, flow, and psychological absorption to show engagement in the game (Brockmyer et al., 2009). Brockmyer and colleagues (2009) tested the 19 question GEQ on 153 junior high students as a subset of questions in a study about media habits. This study verified

BACKGROUND

that “Rasch analyses provide support for reliability and functionality of the GEQ scores” (Brockmyer et al., 2009, p. 630). This study focused on the validity of the GEQ, but it also showed the factors that impact engagement, which the questionnaire is used to assess.

An advantage of these two questionnaires is that they are already validated for use within specific populations. However, validation in one population does not infer that is a valid instrument to use with another population. Furthermore, the questions are not necessarily all useful for an assessment of the blended version of Change Navigator. Changing the validated instrument to include only useful questions requires reassessing the validity of the altered instrument. For further explanations on the validity and setup of the questionnaires, refer to Objective 1 in the Methods chapter.

Interviews

Interviews can create quantitative or qualitative data based on the type of questions asked. Quantitative research explains “what is happening,” while qualitative research explains “why something is happening” (Gammon, 2001). Interviews are useful because they allow the interviewer to “probe for more detailed or useful answers” (Gammon, 2001). Interviews are also very time-consuming which can create a challenge (Gammon, 2001). There are two types of questions: open-ended and closed questions. Open-ended questions require more time, especially in the analysis phase, because they provide many different answers. Open-ended questions can be analyzed using content analysis; more information can be found about this topic in the Methods section under Objective 2. Closed questions include yes/no questions, number scales, rating scales, scale of agreement, semantic differentials, and multiple choices (Gammon, 2001). Closed questions only allow for a certain number of different answers, making analysis quicker and easier.

BACKGROUND

Think Aloud Protocol

The premise behind a think aloud protocol is for participants of a task to voice their opinions out loud as they perform the task. This is a method that researchers used most often to identify both small and major issues with the topic of interest (Faulkner, Finlay, & Détienne, 2002). Several studies have shown that a think aloud method is better than both interviews and questionnaires at identifying problems and leads to more instantaneous reactions than post-task interviews and questionnaires (Charters, 2010; Gołębiowska, 2015; Someren, et al. 1994; Stefano, et al. 2010). According to Nielsen (1993), another major drawback to the method “is that it does not lend itself very well to most types of performance measurement” (p. 195). However, Nielsen (1993) also states that, “its strength is the wealth of qualitative data it can collect from a fairly small number of users” (p. 195).

Heuristic

A heuristic solution is a “best guess” method of solving problems (Pineiro, Andre, & McNeill, 2014). It takes assumptions, personal experience, intuition and common sense to create a model for solving the problem. A few examples of heuristic methods include, trial and error, breaking up problems, looking for patterns in data, generating an equation to resolve the issue, and reverse engineering a problem. People use heuristic solutions in a variety of cases because they are very flexible. The main advantage of using heuristics is that they are good at adapting to the given problem since they rely on user judgement. The major drawback is that they are not rooted in facts, so some researchers do not consider them accurate ways of solving a problem (Pineiro et al., 2014).

Methods

Our goal was to understand how the addition of digital game pieces, which allow for the tracking of players' moves and data handling, to the current physical version of *Change Navigator* impacts players' behavior, decision-making processes, social interactions, and personal gaming experience. More specifically, we aimed to determine if surveillance of gameplay through the use of a conspicuous video camera significantly alters how people play business board games. Such a result would indicate that blending *Change Navigator* is likely disadvantageous. To meet our goal, we set forth the following objectives:

1. Develop and pilot test potential methods of assessing players' behavior, decision-making processes, social interactions, and personal gaming experience while playing both blended and non-blended board games.
2. Model how to assess the effects of surveillance on player's behavior, decision-making processes, social interaction, and personal gaming experience while playing blended games using both pilot tests and generated random mock gameplay data.

The timeline for our process is found in Figure 5 below.

METHODS

Testing Schedule					
Week	Mon	Tues	Wed	Thurs	Fri
Wk 1 March 14th – 18th	Learned Change Navigator		Contacted Professors to Recruit Participants		
	Prepared Advertisement of Study to Recruit Participants		Learned Co-Creator	Prepared for Testing	
Wk 2 March 21st – 25th	Prepared for Testing		Tested WPI Students (2 non-blended) (2 blended)	Easter Break	
Wk 3 March 28th – April 1st	Easter Break	Analyzed Pilot Testing Data	Participated in a Gaming Study	Revised Introduction, Background, and Methods	
			Analyzed Pilot Testing Data		
Wk 4 April 4th – 8th	Revised Methods	Met with Povl's Advisor at CBS	Recruited Participants at CBS	Wrote Results	Updated Presentation
			Updated Presentation		
Wk 5 April 11th – 15th	Recruited Test Subjects/Analyzed Data & Wrote Results/Updated Presentation				
Wk 6 April 18th – 22th	Generated Random Data	Analyzed Random Data	Test Danish Students & Professionals (1 blended)	Test Danish Students (1 non-blended)	Wrote Results & Conclusions
	Wrote Results & Conclusions				
Wk 7 April 25th – 29th	Practice Presentation	Finalize Report/Create Presentation			Presented/Submitted Report

Figure 5: Project Timeline

OBJECTIVE 1: PILOT TESTING POTENTIAL METHODS

Develop and pilot test potential methods of assessing players' behavior, decision-making processes, social interactions, and personal gaming experience while playing both blended and non-blended board games.

The purpose of this objective was to determine and then refine the best method of assessing player's behavior, decisions, social interactions, and gaming experience while playing blended and non-blended board games. Several methods have been used in the field of game design and usability testing to evaluate the quality of a game in terms of personal (single-user) gaming experience and social (inter-player) experience (Ip & Cooperstock, 2011). After reviewing numerous studies with goals similar to ours, we selected and combined three frequently used methods of analysis to pilot test on a convenience sample of 20 university

METHODS

students from Worcester Polytechnic Institute (WPI) in four groups of five. We then revised our method and conducted an additional pilot test on one group of four Danish university students and business professionals and another group of 6 Danish university students, recruited through various connections and media platforms. All participants were over the age of 18.

Since a blended prototype of *Change Navigator* does not exist, we were free to use any business board game to conduct our tests. During our pilot tests participants played *Co-Creator*, which is another educational board game produced by Gametools about innovation in the Danish public sector. The game mechanics of *Co-Creator* closely relate to that of *Change Navigator*, which allowed us to easily adapt our methods between the two games. We used *Co-Creator* instead of *Change Navigator* for several reasons. The topic of *Co-Creator* is much more relatable for university students who have previous experience working on innovative group projects. These students would likely have little experience in management, which would make playing *Change Navigator* more difficult. Additionally, *Co-Creator* takes about an hour to play, instead of the five to six hours required for *Change Navigator*, making it much easier to recruit participants.

Participants were filmed as they played two different configurations of *Co-Creator*, simulating the non-blended and blended versions of the game. Then, students responded to a questionnaire and participated in a group interview. Since we filmed participants, used a questionnaire, and recorded interviews, we used a written consent form as seen in Appendix A. While there was no risk of harm to the participants in this study, because we recorded audio and video footage, we thought it was best to obtain consent before testing. All information collected was kept confidential.

Pilot testing our method served several purposes. We used the pilot tests to discover if analyzing gameplay film was logistically feasible and allowed us to track all movements and actions throughout gameplay. Pilot testing also enabled us to evaluate how well we framed

METHODS

the non-blended and “blended” versions of the game through our setup and introduction. Pilot testing our interview questions and questionnaires allowed us to determine if our questions were clear and yielded useful information. Lastly, we used these tests to determine if our group interview format and questions provided useful descriptions of players’ experience in a timely manner.

Testing Population

Our testing group was a convenience sample because we used students and business professionals who were easily accessible to us through our connections with WPI and Gametools (Laerd Dissertation, 2012). Convenience sampling was necessary because our study required participants to travel to a testing location and commit two hours of their time. Therefore, it was easier to recruit participants who had personal connections to Gametools or had a particular interest in the general topic of our study. While this type of sampling was quicker and easier, it had some disadvantages. Statistical analysis is typically based on the idea that a sample is randomly selected from the entire affected population, which helps remove potential bias (Smith, 2012). Therefore, our sample may not be completely representative of the true business population that Gametools hopes to market *Change Navigator* and *Co-Creator* towards. However, we assumed that university students and business professionals were sufficiently representative of the type of people who ordinarily play *Change Navigator* and *Co-Creator*.

A major limitation of our method was that we used WPI students who were informed of the purpose of our study prior to participating in our first round of pilot tests. This introduced a major bias into our pilot tests because the students already knew that we were examining how surveillance impacted their gameplay decisions. Therefore, the pilot tests did not provide unbiased data, but rather allowed us to refine our testing instruments for future use.

METHODS

Simulation of Non-Blended and “Blended” Board Games

Since a blended version of *Co-Creator* does not exist, we used two different pre-play introductions and filming (i.e. surveillance) setups to simulate a non-blended and “blended” version of *Co-creator*. In all pilot tests, we used cameras built into laptops to record footage of gameplay. To simulate surveillance created by a blended game, we made the recorded footage visible to the “blended” pilot test groups as they played, similar to a mirror. For the non-blended version, our computers displayed a nondescript desktop background while filming to minimize the impacts of surveillance. The non-blended and “blended” configurations are represented in Figure 6.



Figure 6: (a) Non-Blended Configuration (b) "Blended" Configuration

METHODS

Figure 7 shows one potential way of setting up the “blended” version.



Figure 7: Potential "Blended" Configuration

The use of a visible camera to record play of the non-blended version of *Co-Creator* was a potential limitation of our method because the non-blended version does not typically use video recording. However, we needed to record the data from the non-blended game as well. We assumed that the benefits of recording players' actions outweighed the potential detriment of impacting players' behaviors.

In addition, we used different scripts to introduce each version of the game. When introducing the “blended” version of *Co-Creator*, we emphasized the idea that players' actions were being surveilled. We also offered the “blended” groups an incentive to beat the other teams based on their final score and actions throughout the game. This reinforced the idea that the actions taken during gameplay had consequences beyond the game. For the non-blended version, so that groups played more recreationally, we simply offered the incentive as compensation for testing. We also stressed that we were only filming to see if the changes to game mechanics created a better experience for the players. Our pre-play instructions for the two different versions can be found in Appendix B.

METHODS

Typically, in studies comparing two versions of a game, the participants would play both versions. This helps eliminate variables. However, Gametools' games are usually one-time use. Consequently, participants only played either the non-blended or "blended" version of *Co-Creator*. In the first round of pilot tests, there were two non-blended groups and two "blended" groups. In the second round, there was one non-blended group and one "blended" group. We then compared the data from participants who played the non-blended version to the data from those who played the "blended" version. Given that the students shared similar experiences, and interests, we assumed that confounding factors were mostly negated.

Videotaping Gameplay Decision-Making

Evaluating players' decision-making process is especially important in this study since we hypothesized that the addition of surveillance would influence players to make "safe" moves during gameplay. We analyzed gameplay by reviewing film rather than through in-person observation because recording the placement of all of the game pieces in person would likely affect the players' behavior more than a camera. However, not taking field notes during gameplay was a potential limitation of our method. Jordan and Henderson (1995) suggest that writing field notes concurrently while filming is advantageous because such notes may be able to "explain otherwise inexplicable occurrences and avoid false interpretations" (p. 88) since the camera angle provides a limited view. While this may be true in some cases, video recording captured every aspect necessary to perform our study. In addition, by using video rather than direct observation, we were less limited in terms of how many teams could play simultaneously. This meant that we were only restricted by the number of available recording devices and games, not by the number of researchers present.

The riskiness of players' actions can be evaluated through film analysis in several ways. Each action that the players' collectively take is associated with a particular level of perceived risk. In *Co-Creator*, groups are faced with a challenge concerning the implementation of an

METHODS

innovative project. For each challenge, the group must choose from three different solutions, each of which has a different price in terms of resources as well as an unknown outcome. As a result, each solution is associated with a different level of perceived risk. The selection of a solution in *Co-Creator* is similar to the selection of an action card in *Change Navigator*. For example, in *Change Navigator*, most players would perceive the “Kill a Freedom Fighter” (firing an employee as a scare tactic) action card as a risky business decision. On the other hand, most players would perceive the action card “Reward Change Efforts” (management rewards good behavior with bonuses) as less risky. Through reviewing gameplay footage we determined which solutions were used by each group and recorded this information in *Co-Creator* Gameplay Tracking Sheets found in Appendix C. Since we were concerned with how the participants’ decisions were impacted by surveillance, we assumed that understanding how they perceived the riskiness of their actions was more significant than understanding expert opinions on the risk associated with each solution. Therefore, after the interview, participants of our study ranked the solutions for each challenge in *Co-Creator* by riskiness from 1-lowest risk to 3-highest risk. This form can be found in Appendix D. From this, we calculated an average “risk value” for each solution. Based on the “risk value” associated with the solutions selected by each group, we determined the average riskiness of each groups’ decisions. This enabled us to compare the average riskiness of decisions made by the non-blended and “blended” groups. To perform this task while assessing *Change Navigator*, instead of ranking solutions, participants would sort the cards into the risk categories: low, medium, and high. We would also use the *Change Navigator* Gameplay Tracking Sheets found in Appendix E.

Another way to assess the riskiness of players’ decisions through reviewing gameplay footage is to record the number of resources used for each solution relative to the number of available resources. At the start of playing *Co-Creator*, the group received a finite number of resources to implement solutions. Using a solution that expends most or all of one type of

METHODS

resource, and thus limiting future choices, is a risky decision. Therefore, after every challenge, we recorded the fraction of each type of resource used into the *Co-Creator* Gameplay Tracking Sheet. If a necessary resource card is unavailable, the group can choose to take a delay card (Figure 8) in place of this resource as a penalty.



Figure 8: *Co-Creator* Delay Card

The accumulation of delay cards negatively impacts a group's score at the end of the game. Therefore, we also recorded the number of delay cards voluntarily accumulated during gameplay because opting to take a delay card is also a risky decision.

In a similar manner, when assessing Change Navigator, the number of change fuel chips used on a single action card would be assessed. Players can use up to four action cards during each round of play to persuade departments to agree with change. Action cards are applied one-by-one so that subsequent action cards can be chosen according to the outcome of the previous action card. Players do not know the outcome of an action card until after the card is irrevocably selected and applied to departments with change fuel chips. Consequently, it is risky to “put all your eggs in one basket” by using most, or all, of the change fuel chips on one action card as shown in Figure 9a below. A “safer” move would be to save some change fuel chips for subsequent action cards in the event that the selected card has unexpected consequences as demonstrated in Figure 9b. Therefore, a high number of change fuel chips applied to a single card indicates riskier decision-making. We would compare the number of

METHODS

change fuel chips used per action card between the two versions of the game to evaluate the riskiness of players' decisions.

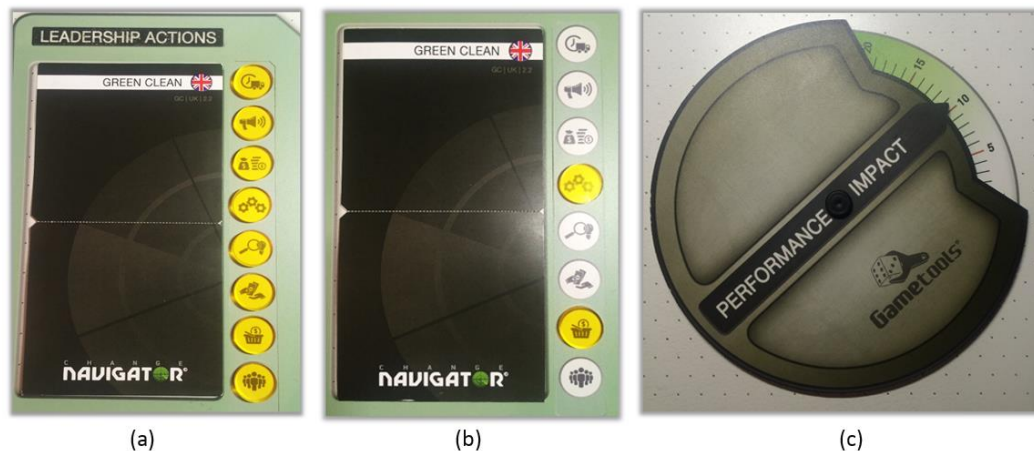


Figure 9: Assessing Player Decision Making: (a) Risky Change Fuel Use (b) Safer Change Fuel Use (c) Performance Impact Score

Throughout gameplay, we recorded each group's score and duration of play. This information may not be useful. However, if the teams who play one version (“blended” or non-blended) consistently score higher, or complete the rounds more quickly than their counterparts, it would indicate a more positive user experience. In *Co-Creator*, scores are measured by innovative culture, innovative solutions, and goal attainment scores. We recorded these three scores after each challenge and the final average score in the *Co-Creator* Gameplay Tracking Sheet. In *Change Navigator*, the team’s score would be measured by the “Performance Indicator” (Figure 9c) after every round.

Evaluating Personal Gaming Experience and Social Presence through Questionnaires

Several studies comparing users’ experiences while playing fully physical and hybrid games have relied on post-play questionnaires to provide quantitative results. In Ip and Cooperstock’s (2011) study comparing a physical, blended, and digital version of the same game, participants completed a questionnaire immediately after gameplay. The questionnaire comprised of questions from the Game Experience Questionnaire (GEQ) and Social Presence

METHODS

in Gaming Questionnaire (SPGQ) developed by FUGA: The Fun of Gaming Measuring the Human Experience of Media Enjoyment project. These two questionnaires ask participants to indicate their level of agreement with statements about the realness of the game, how focused they were during gameplay, and their involvement with other players. Kulšinskas and colleagues (2015) also used the SPGQ to study of the impacts of digital augmentation through the addition of smartphones on social presence. These two studies suggest that the GEQ and SPGQ are applicable to digital, physical, and hybrid games. In both studies, participants responded to the questionnaire using a 5-point Likert scale. By averaging players' ratings, the researchers quantitatively demonstrated the differences between the three versions of the game for various aspects such as aesthetics, perceived usability, and behavioral involvement. The GEQ and SPGQ have been validated by several other independent studies (De Grove, Looy, Neys, & Jansz, 2012; De Kort, IJsselsteijn, & Poels, 2007; Norman, 2013).

After gameplay, we used an adaptation of the GEQ and SPGQ to provide quantitative data about players' enjoyment, interactions with others, and immersion throughout the game. Although we kept the GEQ and SPGQ questions mostly the same, we modified, added, or removed statements to make the questionnaire more applicable to *Co-Creator*. For instance, several GEQ and SPGQ statements are related to competition between players. However, these statements were not relevant to *Co-Creator* because all players work cooperatively to achieve the highest possible score. The *Co-Creator* questionnaire can be found in Appendix F. Such modifications to the questionnaire can also be made for Change Navigator, as shown in Appendix G. Players responded to the questionnaire statements using a 5-Likert or 5-Likert-type scale (strongly agree to strongly disagree). Although many of the Likert items and groups from the tests remained the same, there is a possibility that removing and modifying some questions made the instrument invalid.

Pilot testing the questionnaire helped us identify confusing statements and revealed deficiencies in the instrument. Since Gametools is considering integrating a post-play survey

METHODS

into the blended version of Change Navigator, pilot testing our questionnaire also evaluated potential post-play survey questions for the company.

Interviewing Players for a More Complete Understanding

After participants completed the questionnaire, we interviewed players in their teams about their experience using a semi-structured format. Kulšinskas et al. (2015) suggested that the use of open-ended interviews in addition to filming gameplay and using a questionnaire “provided a more complete picture of the interaction and user experience” (p. 490). The use of semi-structured interviews enabled players to discuss and elaborate on parts of their experience that would not have been adequately expressed through a questionnaire. Semi-structured interviews also allowed for flexibility in our questions while maintaining some consistency between interviews. During our interview, we asked students questions about their level of enjoyment, group decision-making, and the impact of the camera’s presence while playing *Co-Creator*. Our list of interview questions for *Co-Creator* can be found in Appendix H. One researcher interviewed each team of players. The group’s response was recorded as one data point into a coded interview sheet (Appendix I), which allowed us to filter responses into pre-decided categories. This enabled us to count the frequency of certain comments which translated into thoughts and feelings for each question. The interview questions, if used for Change Navigator, would be slightly modified as shown in Appendix J.

We used group interviews rather than individual interviews because individual interviews were time-prohibitive. In addition, we wanted all instruments measuring risk to use the opinion of the group as a whole due to the cooperative nature of gameplay consistently. However, during group interviews, we remained cognizant that participants might have agreed with another player’s response rather than giving original, articulated responses, which may have yielded less accurate data. As with the questionnaire, pilot testing our

METHODS

interview questions also helped us to determine if our questions elicited meaningful information or if they confused the participants.

OBJECTIVE 2: ASSESSING THE IMPACTS OF SURVEILLANCE

Model how to assess the effects of surveillance on player's behavior, decision-making processes, social interaction, and personal gaming experience while playing blended games using pilot tests and generated random mock gameplay data.

The purpose of this objective was to demonstrate how to use the methods developed in Objective 1 to assess the impacts of adding data mining and surveillance to Gametools' business board games. Due to a lack of participants, we were not able to collect enough data to perform a statistical analysis. Therefore, we generated random mock games of *Co-Creator* to model how to use the proposed statistical tests. We then described how to interpret the results of statistical analysis to determine whether or not adding digital elements to educational board games impacted players' actions and experience.

We generated 24 games of *Co-Creator*, 12 for the "blended" version and 12 for the non-blended version. This gave us 12 data points for analysis at the group level. We chose to simulate 24 groups of gameplay because this was the original number we thought was feasible if we performed the actual experiment. One major limitation of using random data is that when taking averages, there is little variation in the results. Therefore, we used the data collected during the pilot tests and recommendations from Gametools to provide information that is more representative of human variation. While data that has been generated randomly serves the purpose of demonstrating our statistical methods, it does not perfectly reflect how a human would act in the same situation. It is also not possible to use the data generated to say anything decisive about how surveillance would affect gameplay.

METHODS

Figure 10 below summarizes the statistical tests used to analyze and compare gameplay of the non-blended and “blended” versions of *Co-Creator*.

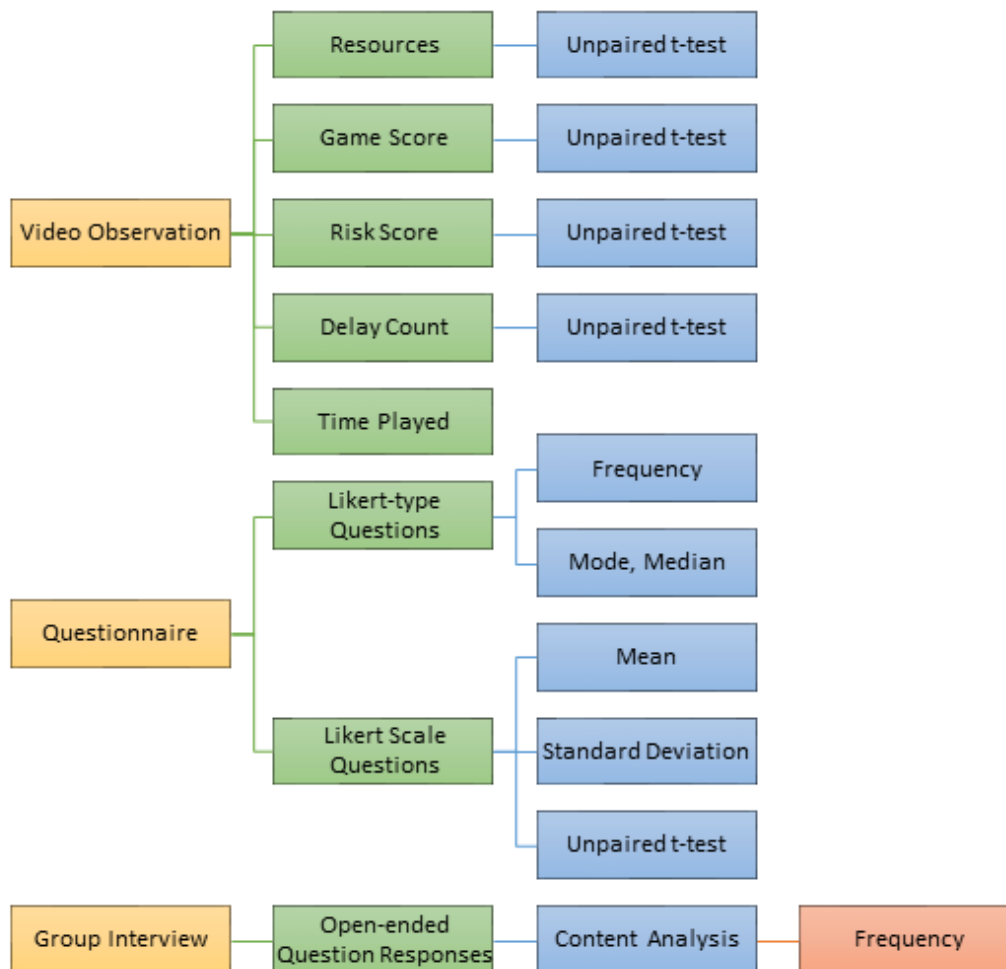


Figure 10: Flowchart of Methods, Results, and Data Analyses

Generation of Random Gameplay Data

In order to generate random mock playthroughs of *Co-Creator*, we created a computer program in Java as seen in Appendix K. This program uses the built in “Math.rand” function to randomly select sponsors and solutions throughout the game. After initial tests were run, we decided that it was “too random and unrealistic” to be a plausible simulation of human

METHODS

gameplay. In order to combat this, we gathered information from the Gametools staff, based on their experience facilitating the game, to better simulate how humans would play. We refined our data generation program to check to see if the required amount of resources were available to take an action before taking it. Technically, a solution can be selected even if the necessary resources are not available by taking a delay card. However, human players almost always avoid using more resources than they have. Therefore, to simulate this behavior, if the given test did not have some of the resources required to select the solution, then it would re-randomize to get a new action, which could be the same as the one previously taken. It would keep doing this until it either: found a suitable action or looped ten times and conceded to take the delay(s).

As the initial sponsors are randomly generated, the starting resources are also random and may result in a very uneven distribution of resources. This can lead to a disastrous playthrough because the program will have to take numerous delays to compensate for the lack of certain types of resources. To account for this problem, we limited the number of delays that could be accrued during a test run. The Gametools staff recommended that the maximum be set to five. Finally, we set a minimum final score of two, as it was deemed too poor for an actual human to achieve. It is impossible to perfectly emulate human behavior using random number generators. However, the developed Java program offers us a reasonably close approximation of realistic data.

Theoretically, this approach could be expanded to simulate the expected effects on risk taking. Using the pilot test data to understand which solutions people perceive as risky, we could have rigged the computer to either play more or less riskily-- depending on which version (non-blended or "blended") it was simulating. This would only provide model of our hypothesis of how surveillance affects player's actions during a game, so we decided against using this method.

METHODS

Analyzing Gameplay Data

Using the computer program described above, we generated data representing the type of information that would be collected through reviewing gameplay footage for 12 non-blended and 12 “blended” test groups. First, we looked at the average fraction of resource cards used per resources available throughout the entire game for each group (Appendix L). To calculate this average fraction, for each of the nine challenges, we found the fraction of resource cards used to implement a solution relative to the number available for each of the six resource types. We then found the average fraction of resources used for each challenge, excluding the types of resources not needed to implement the solution. We then averaged this value for all nine challenges. An example calculation of a group’s overall resource fraction is shown in Figure 11 below.

Example Resource Fraction Calculation

Challenge 1 Solution Price: 2 legwork and 1 commitment
Available Resources: 3 legwork, 1 commitment, 4 network, 2 mandate

Calculate the fraction of resources needed relative to the number available for each type of resource:

$$\frac{\text{legwork needed}}{\text{legwork available}} = \frac{2}{3} \quad \frac{\text{commitment needed}}{\text{commitment available}} = \frac{1}{1}$$

Find the average resource fraction for each challenge:

$$\frac{\frac{2}{3} + \frac{1}{1}}{2} = \frac{5}{6} = 0.83$$

Then find the average resource fraction for all 9 challenges.

Figure 11: Example Resource Fraction Calculation

Using a higher overall percentage of resources, similar to going “all-in” in poker, is riskier than using a lower percentage of resources. We also evaluated the final average game score for each group to determine if there was a significant difference in scores between the two versions (Appendix M).

METHODS

In addition, we considered the number of Delay cards used to decipher if there was a significant difference in the number used between versions. The game states that while players can use Delay cards if out of a needed resource, there will be penalties at the end of the game for using them. Delay cards can also be accrued randomly throughout the game as consequences for solutions and cannot be avoided if given. With the looming penalties, Delay cards are thought of as risky. A significant difference in game score, the average fraction of resources, or Delay card count between the two versions would indicate that surveillance impacts gameplay decisions and behavior.

The resource card percentages, overall game score, and Delay card count were compared using an unpaired t-test, which compared the mean of the control (non-blended) with the mean of the experimental (“blended”) group to prove if there was a statistically significant difference. We used an unpaired t-test because the individuals are not matched like a before-and-after case (Otto Von Guericke Universitat - Magdeburg, 2016). While the use of random data nullified the need to perform the Mann-Whitney U test, in a future study, we might need to check our results with the Mann-Whitney U test, which is “designed for non-parametric analog to the independent samples t-test and can be used when you do not assume that the dependent variable is a normally distributed interval variable” (Otto Von Guericke Universitat - Magdeburg, 2016). This would be necessary if the study met the following criteria: a normal distribution is not assumed, the dependent variable is ordinal or continuous (which includes Likert items), the independent variable has categorical groups (“blended” and non-blended), and there is an independence of observations (Laerd Statistics, 2013).

In a similar manner, an unpaired t-test and possibly the Mann-Whitney U test would be used to assess the riskiness of decisions made while playing Change Navigator. These tests would be used to analyze the number of change fuel chips used per action card. Using a greater number of change fuel chips per action card indicates riskier decision-making. If

METHODS

players of the blended game tended to use more evenly distribute change fuel chips among action cards, that would indicate that the addition of surveillance impacted their actions. In *Change Navigator*, the overall score from the performance impact dial would also be assessed with the unpaired t-test and possibly the Mann-Whitney U test to see if there is a significant difference between the non-blended and blended versions.

During the first round of pilot tests, teams ranked each challenges' solutions from the least risky to the riskiest (one through three, respectively), disregarding what they learned about outcomes during gameplay. Based on this data, we created a standard, average risk score for each solution. To model how to assess groups' decision-making processes for *Co-Creator*, we analyzed the riskiness of the solutions selected for each computer-generated playthrough. We used the average risk score for each solution from the pilot tests instead of computer-generated data when modeling the statistical analysis. This is because, given a large enough sample size, computer-generated data would have produced the same average riskiness for all of the solutions. We used this standard risk score, developed from the pilot tests, to assess the 9 solutions that the program chose for each playthrough. The test run was then given an overall average risk score, which can be compared to other tests. We performed the unpaired t-test on the overall risk score averages for non-blended and "blended" to see if the results were statistically significant.

Likewise, *Change Navigator* would be assessed according to the riskiness of each action card chosen. Based on our risk score ranking in Appendix D, we would look at the cards chosen and their associated risk ranking of low, medium, and high. We would also assign our ranking system a numerical value, which would allow us to give each group an overall risk score that would be compared using an unpaired t-test and possibly the Mann-Whitney U test.

To evaluate the user's experience in *Co-Creator*, we looked at the length of each round to see if there were any differences in playing time between the non-blended and "blended"

METHODS

versions. Longer rounds could indicate that there was more discussion, which could mean a better and more worthwhile experience. However, the addition of surveillance in the “blended” version could increase discussion if participants feel that their choices actually matter and their voices need to be heard. In addition, when assessing a true blended prototype, longer rounds could indicate that the added digital technology makes learning to play the game more difficult. Therefore, significant differences in time of play, must be analyzed in conjunction with the types of conversations captured in the video footage. *Change Navigator* also contains rounds of play and can be interpreted using this approach.

Analyzing Questionnaire Data

The *Co-Creator* questionnaire we created uses both Likert scale and Likert-type information and can be seen in Appendix F. Likert scale is the term used when the series of questions can be combined to describe a trait or attitude (Boone Jr & Boone, 2012). The questions provided by the GEQ and SPGQ are Likert scale questions. From the GEQ, immersion, presence, flow, and absorption are the groups analyzed. Immersion “describes the experience of becoming engaged in the game-playing experience while retaining some awareness of one’s surroundings” (Brockmyer et al., 2009, p. 624). Presence can be described as “being in a normal state of consciousness and having the experience of being inside a virtual environment” (Brockmyer et al., 2009, p. 624-625). Flow explains the “feelings of enjoyment that occur when a balance between skill and challenge is achieved in the process of performing an intrinsically rewarding activity” (Brockmyer et al., 2009, p. 625). Absorption reports the “total engagement in the present experience” (Brockmyer et al., 2009, p. 625). From the SPGQ, Psychological Involvement - Empathy, Psychological Involvement - Negative Feelings, and Behavioral Engagement/Involvement are the groups analyzed. Psychological Involvement - Empathy measures “positive feelings of togetherness (enjoyment of social context, connectedness, empathy, sympathy, and admiration)” (De Kort et al., 2007, p. 4). Psychological Involvement - Negative Feelings describes “negatively toned emotions (jealousy,

METHODS

revenge, schadenfreude or malicious delight)” (De Kort et al., 2007, p. 4). These Psychological Involvement groups recount the “toned emotions towards co-players” in each of these two categories (De Kort et al., 2007, p. 7). Behavioral Involvement measures “the degree to which players feel their actions to be dependent on their co-player's actions” (De Kort et al., 2007, p. 7).

Some questions that are included in the verified SPGQ and GEQ tests did not apply to *Co-Creator* or *Change Navigator*. We modified these questions to better fit the game content, which deleted, added, and modified questions in some groups. We decided that the changes were close enough to the original questions or group themes to leave them in the predetermined groups. However, since we made these adjustments, some groups are no longer valid from previous SPGQ and GEQ testing. This may skew some of the Likert scale results we analyze.

Likert-type means that the questions are individual and can stand-alone (Boone Jr & Boone, 2012). It is important to note that while most of the questions are catered towards understanding behavior, decisions, and experience and stems from the SPGQ and GEQ, we included a set of questions that would be useful to Gametools when they implement a feedback survey into their game for players. The questions we added for Gametools' feedback survey are Likert-type. These different Likert question types are meant to be analyzed in different ways. For the Likert-type questions, we used frequencies, modes, and medians (Boone Jr & Boone, 2012). For the Likert scale questions, we used mean, standard deviation, and t-testing (Boone Jr & Boone, 2012).

For *Change Navigator*, aside from customizing the questions, the questionnaire analysis process would follow the same analysis as described for *Co-Creator* above.

METHODS

Analyzing Group Interview Data

Our questions for the interview, as shown in Appendix H, were open-ended and allowed the participants more freedom in his or her answers. In order to analyze this data from the pilot test on WPI students, we changed this qualitative data into quantitative data. We loosely based our analysis on the content analysis method. Content analysis is a method of summarizing content into categories that can be counted (List, 2002). This was a strong method because it is mostly used for comparing survey results from different groups (“blended” compared to non-blended groups in our case). We created categories and filtered the interview responses into these pre-decided categories. This is called coding. By creating the code as seen in Appendix I, we counted the frequency of certain comments which translates into thoughts and feelings for each question. This gave us an understanding of our participants’ thoughts and feelings towards *Co-Creator*. For Change Navigator, minor changes would be made to the interview questions to account for the game name and content as shown in Appendix J. The analysis would follow the same process as *Co-Creator*.

RESULTS AND ANALYSIS

Results and Analysis

OBJECTIVE 1: PILOT TESTING RESULTS

From our pilot tests, we determined that our methods for filming, interviewing, and data collection were logistically feasible. We were able to analyze the data that we collected and gather qualitative information regarding the impacts of surveillance and gameplay. However, due to the small sample size of the pilot tests and the biased nature of our participants, the results cannot be interpreted as indicative of significant trends.

Inconsistent Order of Testing Instruments

After our first round of pilot tests, we discovered that we did not distribute our testing instruments in a consistent order. While all groups in the first round of tests filled out the questionnaire before participating in the group interview, the risk ranking form was completed at different stages in the process. This type of inconsistent process likely did not severely impact our results. However, using an inconsistent order introduces an unnecessary variable regarding the time between play and participants' evaluation of the solutions' riskiness.

For our second round of pilot tests, we used a fixed order for the debriefing process. The questionnaire was given first, followed by the group interview and then risk ranking form. This made the transitions smoother and testing more uniform.

Pre-play Instructions

Although participants were informed prior to participating that they would be filmed and consented to this process, we hoped that by using an inconspicuous camera, players of the non-blended versions would not be bothered by the presence of a camera. However, during our introduction to the non-blended version of the game, several participants in the first round questioned the presence of the laptops and whether we were filming them. This

RESULTS AND ANALYSIS

likely occurred because the WPI students involved in our pilot study knew of our methods prior to participating. In the non-blended second round pilot test, the Danish university students did not question the presence of laptops. However, we discovered that if such questions about video recording arise, it is better to admit that we are filming rather than avoid answering their questions. In one group, the researcher responded to these questions by claiming that we were simplifying evaluating the game and instructed players to “just have fun.” In another non-blended group, the researcher ignored such questions, which made the participants suspicious.

During our introduction to *Co-Creator*, we described two major modifications to the game. To better track players’ moves, we asked groups to use small wooden blocks instead of cards to indicate the number of resources they possessed as shown in Figure 12.



Figure 12: Visualization of Resources

This allowed us to easily visually note how many resources the groups possessed without affecting gameplay. We also changed the pawns marking the three score parameters from clear red to solid black tokens to improve visualization. Additionally, to expedite gameplay, we instructed groups to skip the reflective sections called “Back to Reality.” While most players understood our changes to the games, some experienced confusion. As a result, it is important to ensure that clear explanations of the modifications are given during the introduction.

RESULTS AND ANALYSIS

During the second round of pilot tests, we discovered that we must give participants a more thorough explanation and description of *Co-Creator* before play. Before beginning play, one participant stated “I have no clue what I’m about to do” and “needed basic questions answered” such as:

- “Who is game developed for?”
- “What’s the purpose?”
- “Who are the participants?”
- “Are we a group or are we competitors?”
- “What is the expected outcome?”
- “Is it work-related or is it just for fun?”

We likely did not encounter this issue during the first round of pilot tests with our classmates because they had a general understanding of *Co-Creator* prior to participating. Therefore, our introduction to the game should incorporate these facts so players have a better understanding of *Co-Creator*, who plays it, why people play it, and what should be learning from playing. The improved pre-play instruction notes can be found in Appendix N.

Video Observations

By reviewing video footage of gameplay, we were able to record all choices made during play of *Co-Creator*. The limited view from the use of one camera made it challenging to see certain aspects of the game board. During the second round of pilot tests, players also unexpectedly leaned in front of the camera and placed objects such as a water glass in front of the lens, which obscured the view of the game board as shown in Figure 13.

RESULTS AND ANALYSIS



Figure 13: Obstructing View of Game Board

This made it almost impossible to visually record the resources used during play. However, in all pilot tests, when we could not see the game pieces, audio of players' discussion allowed us to determine which stakeholders or solutions were selected. From this information, we then calculated groups' final score and resource allocation.

While reviewing footage of gameplay, we discovered that several groups misinterpreted *Co-Creator's* instructions or made mistakes. For example, one group did not begin with the correct initial number of resources indicated by the stakeholder card. That same group also mistakenly interpreted the outcome of one solution as optional. Another group forgot to return resources to the bank when paying for a solution. A third group read the outcomes of each solution before selecting one. We did not anticipate that players would experience such issues because *Co-Creator* is one of Gametools' oldest, most extensively-tested products, which has been on the market for 4 years. This may be because players were not using the game for training or learning purposes and were therefore not as careful during play. Fortunately, the groups' mistakes did not impact the recording of resources. We calculated the fraction of resources used based on the number of resources they actually took, not based on the number they were supposed to take.

While reviewing footage of gameplay we also observed that group dynamics can have a strong influence on the riskiness of actions taken. During the last non-blended group tested,

RESULTS AND ANALYSIS

although many players were opposed to selecting riskier solutions, one strong voice encouraged them to take risky decisions. This group leader suggested that the decisions they made did not matter since it was just a game, and they wanted to finish playing quickly. This supports the idea that players will take riskier actions when there are no consequences associated with the outcome of the game.

During the second round of pilot tests, Danish players took much longer than our classmates to complete the game. This occurred for several reasons. For each phase, the “blended” group exceeded the time limit indicated by the game board. Since these players were older and had more work experience than our classmates, they had longer discussions about the options because they used past experiences to support their opinions. Additionally, the Danish students and professionals playing both versions had trouble understanding some English terminology, which caused them to read through the instruction manual much more slowly than anticipated. Because it took the “blended” group far longer to play than we indicated when they signed up for the study, the participants were agitated during the interviews and two group members left early.

Calculating Resource Fractions

At each challenge, we recorded the number of each type of resource that was available to the team and the price of the solution that they chose. From this, we calculated the number of each resource required to implement a solution relative to the resources available at 9 key points throughout the game (for each challenge). We then found the average resource fraction for each team. A higher average resource fraction indicates riskier decision-making because groups are willing to risk expending all of one resource rather than save resources for later stages in the game. As shown in Table 1, the average fraction of all the “blended” groups was lower than the non-blended groups, which supported our hypothesis that under surveillance, the blended groups would be more cautious about the use of resources.

RESULTS AND ANALYSIS

We also recorded the number of delays voluntarily taken to pay for a solution or to replace a resource that the group did not have. At the start of *Co-Creator*, the instructions indicate that accumulating upwards of three delays may adversely affect the team’s score. Consequently, voluntarily taking a delay is a risky decision. Although the number of voluntary delays are reported in the Table? below, during our pilot tests, we discovered that players frequently misunderstood how to use delay cards and therefore did not understand the implications of voluntarily taking a delay. As a result, recording and analyzing the number of voluntary delays accumulated may misrepresent the riskiness of teams’ actions.

The average resource fraction and number of voluntary delays accumulated for each pilot test is shown in Table 1 below.

Table 1: Pilot Test Resource Fraction Summary

Pilot Test Resource Fraction Summary						
Version	“Blended”			Non-Blended		
	Group 1	Group 2	Group 5	Group 3	Group 4	Group 6
Phase 2	0.62	0.39	0.63	0.61	0.42	0.63
Phase 4	0.43	0.42	0.42	0.52	0.46	0.69
Phase 6	0.55	0.55	0.40	0.52	0.58	0.47
Overall	0.53	0.45	0.48	0.55	0.49	0.60
Average of Version	0.49			0.54		
Total Voluntary Delays	2	2	1	1	1	1
Total Delays of Version	5			3		

Calculating Riskiness of Solutions

Despite knowing the outcomes of each solution, groups did not seem to take this into account when ranking the riskiness of each solution. This is ideal because we wanted to understand how players perceived riskiness when they were selecting solutions (before learning its outcome). In half of the first round of pilot tests, the riskiness of solutions was assessed by the group. In the other half of first round pilot tests, groups ranked solutions’

RESULTS AND ANALYSIS

riskiness individually. We decided that it was more appropriate to have groups rather than individuals perform the risk-ranking since the group selects the solutions during gameplay. In our study, it was more important to understand the group dynamic and its collective voice when it came to the riskiness of potential solutions. Therefore, the test groups in the second round performed the risk ranking as a group. The disadvantage to this method is a reduction in the number of data points collected.

Due to the timing of the second round of pilot tests, we did not include these groups' risk when calculating the solutions' average risk. Still, there were new findings from these tests. The "blended" group had trouble deciding on the risk-ranking form, nearly to the point of being overwhelmed. One player contended that ranking the riskiness of the solutions was too difficult since "everything is risky because of the opportunity cost" associated with choosing one solution over the other two. He followed this statement with, "I don't know if I can use this ranking form." However, we believe the participants felt overwhelmed because they wanted to rush through the form since the study took longer than anticipated. In the end, they decided to only identify the riskiest solutions, making it extremely difficult to interpret this data.

Since half of the groups in the first pilot test performed the risk ranking individually and the other half as a group, we collected 12 risk assessments., which can be found in Appendix O. From these rankings, we calculated an average risk for each solution between 1 and 3 (1-least risky to 3-most risky). For example, since all 12 groups or individuals thought the solution "Breaking the Law" was the riskiest solution for that challenge, the risk of that solution was 3. Figure 14 shows the percentage of individuals or groups that gave each risk value arranged from the least risky to riskiest solution. Figure 15 shows average risk for all 27 solutions ordered from least to greatest risk.

RESULTS AND ANALYSIS

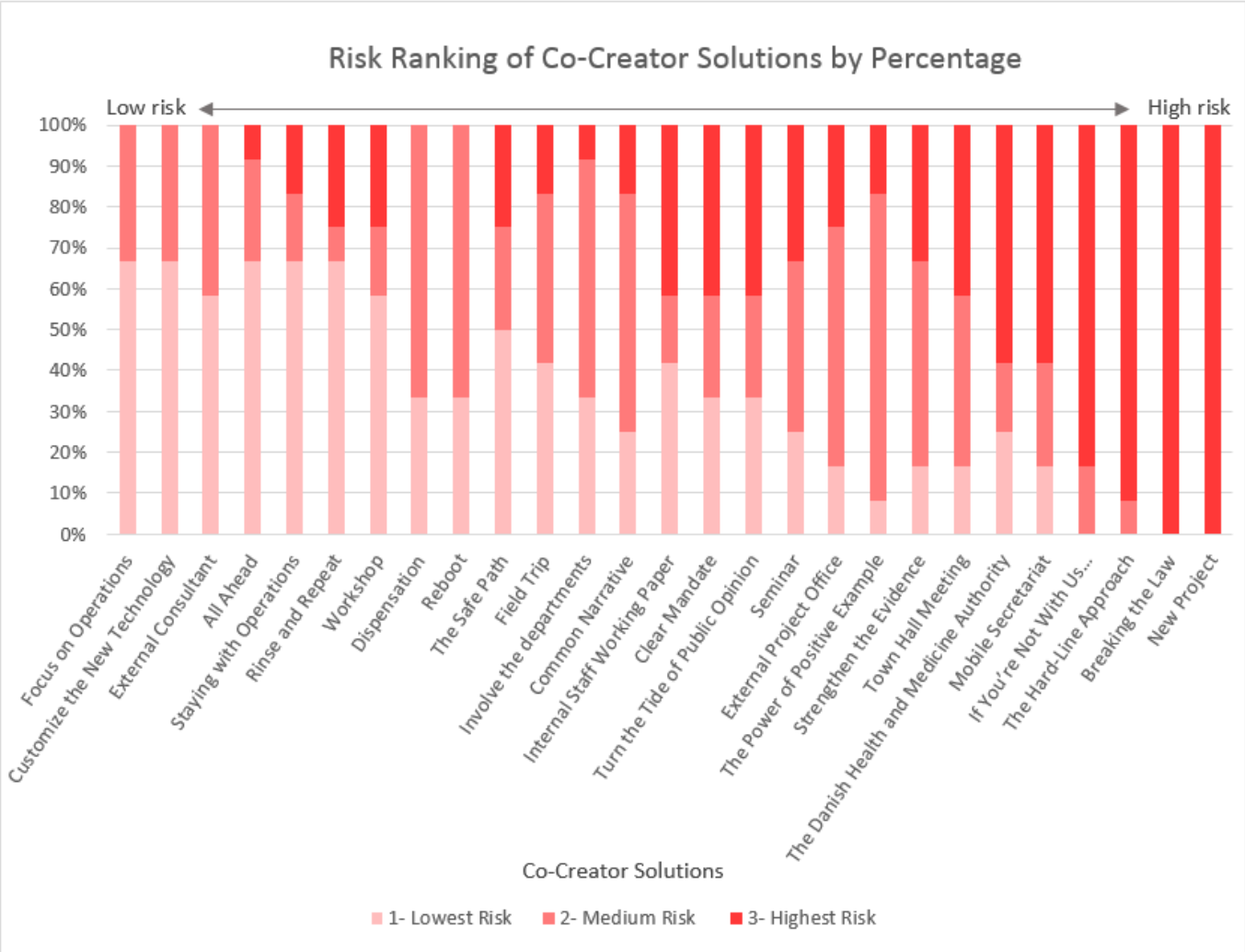


Figure 14: Risk Ranking of Co-Creator Solutions by Percentage

RESULTS AND ANALYSIS

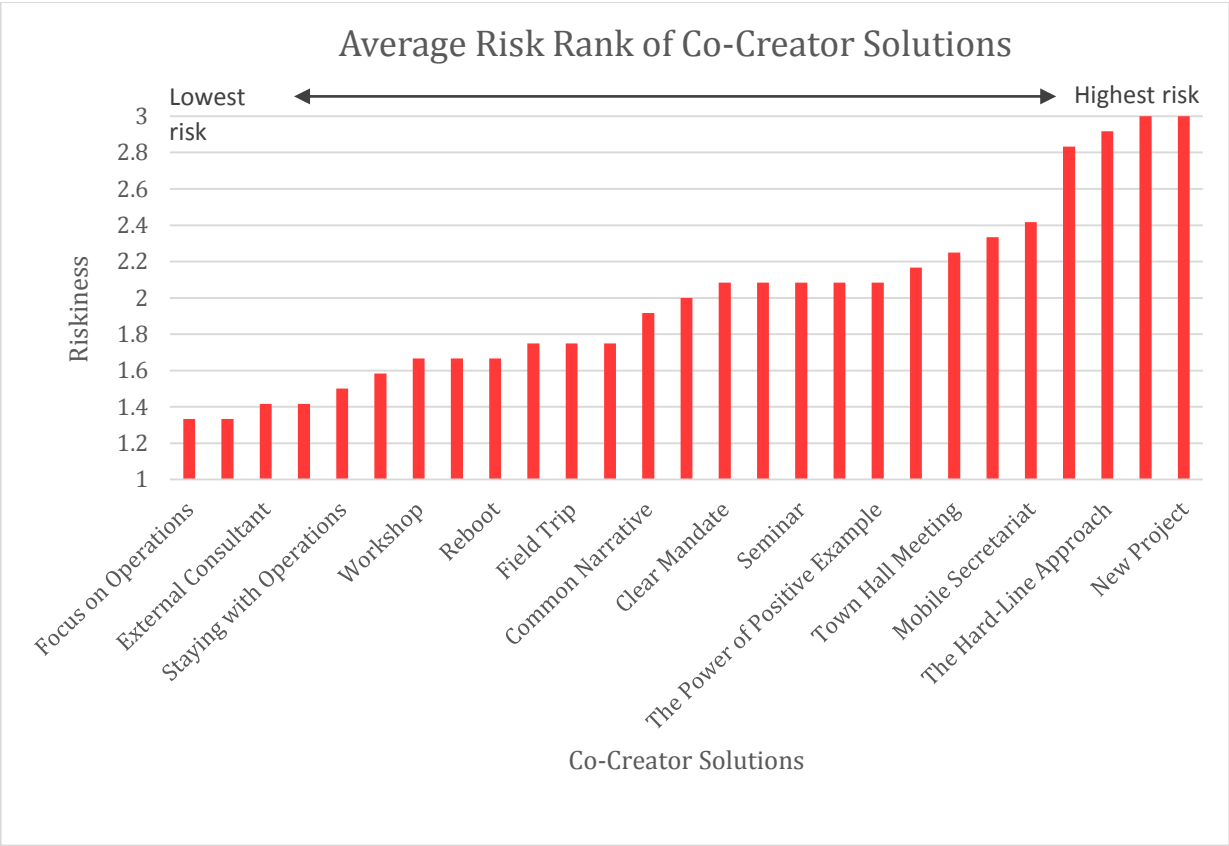


Figure 15: Average Risk Rank of Co-Creator Solutions

Based on the risk score associated with each solution, we calculated an average risk of all the solutions selected by each group as shown in Table 2.

Table 2: Pilot Test Riskiness of Groups' Solutions and Scores

Pilot Test Riskiness of Groups' Solutions and Score						
Version	"Blended"			Non Blended		
	Group 1	Group 2	Group 5	Group 3	Group 4	Group 6
Average Riskiness	1.80	1.96	1.69	1.76	2.22	1.80
Average Riskiness of Version	1.82			1.93		
Final Average Score	5	6	4	5	7	5
Average Final Score	5.0			5.6		

RESULTS AND ANALYSIS

While the difference is slight, the average riskiness of solutions is greater for the non-blended groups than the “blended” groups. This supported our hypothesis that surveillance causes players of the “blended” version to take less risky actions. We also identified a possible correlation between final game score and the average riskiness of solutions across both versions. Final game score increased as the average riskiness of a group’s selected solutions increased. According to Gametools’ Director Povel Gad, *Co-Creator* is supposed to teach people to be less risk averse by rewarding them for taking riskier actions, which is why we see this positive correlation between risk and score.

Questionnaire

The questionnaire provided useful and quantifiable data. The questionnaire results indicated that none of the Likert groups were significantly different between the non-blended and “blended” versions for the first pilot test. This means that the WPI students playing the “blended” version and the non-blended version did not have differing responses about social interactions, personal experiences, and overall gameplay experiences for each of the Likert groups. This data is thoroughly analyzed under the Objective 2 results.

Some players indicated on their questionnaires that the Likert statements confused them. Players were confused by the following statements:

When playing *Co-Creator*....

- I feel different about innovation
- Playing seems automatic
- I play longer than I meant to
- I felt connected to the other players

This confusion may be because the original SPGQ was written in Dutch and has been translated into English for other studies (De Kort et al., 2007, p. 7). However, the English version of the SPGQ has yet to be validated (De Kort et al., 2007, p. 7). We did not eliminate these questions when revising our methods because they were part of the original Likert groups and removing them would further invalidate the questionnaire.

RESULTS AND ANALYSIS

The questionnaire presented two logistical challenges. One disadvantage of using a paper version of the questionnaire is that participants made the occasional error when circling their responses. On several forms, players skipped statements or made unclear markings. A second, unavoidable, disadvantage to using a Likert questionnaire is that un-invested players may respond to the form in a pattern rather than carefully considering their responses, which would skew our data.

Interview

Since our project was more qualitative than quantitative, the group interview yielded the most useful data from our process. During the first round of pilot tests with our classmates, interviews were conducted in an inconsistent manner. Three of the researchers recorded responses to the interview questions as the group's collective opinion. One researcher recorded each group member's response individually. Taking note of each participant's response was time-consuming; one participant remarked that the interview was too long and, had we not been peers, would not have taken the time to respond thoroughly and thoughtfully. Recording individual answers also did not provide any additional information because the participants tended to agree with each other rather than give independent responses. Therefore, during the second round of pilot tests with Danish university students and business professionals, we ensured that the researcher recorded the group's collective response.

One consequence of using our classmates during the first round of testing was that they behaved less seriously than strangers would during the group interviews. The WPI students felt free to discuss their social lives, engaged in side conversations, and asked the researchers personal questions unrelated to the tests. Although participants in the second round of the study did engage in some side conversation, it was far less prevalent because they were not our peers.

RESULTS AND ANALYSIS

Despite the limitations of using our classmates to conduct some of the pilot tests, we gathered valuable information concerning *Co-Creator*, the impacts of surveillance, and our process itself. Based on the interview results from the first pilot test, we revised our interview questions for use in during the second pilot test, which can be found in Appendix P. The coded interview containing the groups' responses can be found in Appendix Q. Below is a summary of all test groups' responses to each question.

Did you enjoy playing Co-Creator? Which parts or aspects of the game made it enjoyable?

During the first pilot test round, for three out of four groups, the group consensus was that playing *Co-Creator* was enjoyable. While testing with Danish university students and business professionals, both groups agreed that playing *Co-Creator* was enjoyable and fun. One player in the "blended" group of the second round even stated, "I lose track of time while playing the game," which is an indication of presence according to the GEQ (Brockmyer et al., 2009). There was not an apparent distinction in the level of enjoyment between the non-blended and "blended" versions. This suggests that surveillance in the "blended" version did not impact players' personal gaming experience, aligning with the results of the questionnaire. Groups indicated that the *Co-Creator* was enjoyable for the following reasons:

Co-Creator....

- Was unpredictable and shocking
- Was challenging due to time constraints
- Provided instant gratification
- Included realistic scenarios
- Allowed players to get to know other players
- Offered new perspectives
- Required reflection
- Provided the opportunity to learn from other players
- Encouraged discussion and debate
- Contained multifaceted decision-making

RESULTS AND ANALYSIS

- Incorporated well-organized game mechanics
- Was easy to play

Which parts or aspects of the game did you not find enjoyable?

Despite being a thoroughly developed game, groups identified the following unenjoyable aspects of *Co-Creator*:

- Excessive reading
- Unclear game instructions
- Large learning curve
- Lack of good/varied options
- Spelling and grammatical errors
- Repetitive gameplay
- Lack of challenge
- Failure of scenarios to align with participant's past experiences
- Lack of a valuable lesson
- Unintuitive/meaningless resources
- Unexpected outcomes of solutions
- Time limit constrained discussion
- Lack of feedback at the end of the game
- Choices did not have consequences later in the game
- Choice of solution depended too heavily on the availability of resources

What improvements do you think could be made to Co-Creator? What aspects of the game did you find realistic or unrealistic?

During the first round of pilot tests, we found that these questions did not provide information relevant to our study. Rather, responding to these questions resulted in a time-consuming criticism of *Co-Creator* for issues with the game's quality such as typos, scenarios that contradicted the player's past experiences, excessive reading, etc. For relevancy sake and to save time, we did not include these questions in the second round of pilot testing.

RESULTS AND ANALYSIS

However, during the first round of pilot testing our classmates made the following recommendations:

- Improve translations from Danish to English
- Fix typos
- Fix headings and titles to be consistent throughout the game
- Provide a better explanation of the delay cards
- Include more opportunities to gain innovative solutions points
- Add complexity
- Improve replay value
- Allow stakeholders to change throughout game
- Give time for players to think individually before group discussions
- Make a copy of the manual available to everyone to read
- Keep track of resources digitally

The last two recommendations are interesting to note and provide justification for producing a blended game. Several players said that incorporating digital elements, such as a tablet or phone app, into a blended version of *Co-Creator* would make it easier and less tedious to read the instruction manual and keep track of resources.

Despite not asking participants of the second round to identify what improvements they would make to *Co-Creator*, they still made several recommendations. One notable recommendation was the inclusion of a form for participants to record their game choices. A player suggested that this form could be used to “keep track of really good and really bad decisions that we made [because] right now, in my head, it’s all blurry.” Another player stated that, “if you had a paper where you could document your way through and then compare it to others... that would have been a fun way to follow up.” The players further suggested that the tracking of players’ actions, followed by a post-play reflection on these decisions and comparison of their performance to other groups would provide a more valuable learning experience. Therefore, this provides yet another justification for producing the blended version of *Change Navigator*, which would track players’ moves to compare to other groups and for use in post-play reflections.

RESULTS AND ANALYSIS

How was playing the game as a group? Did you agree or disagree with the decisions made?

How comfortable were you with the other players?

All six test groups indicated that they enjoyed playing as a group. Several players suggested that they enjoyed working collaboratively to beat the game. One player commented that it was fun because “it’s everyone against the game... and you’re not just trying to screw each other over.” Another player remarked that playing *Co-Creator* “was a good way to get a group to bond while staying relevant to the work.” A third player said, “it’s more about the group than about the game.”

The four groups in the first round indicated that they agreed with the decisions made during play. One group suggested that they unanimously agreed on most solutions because it was obvious which solutions would give the best scores. As a result, there was not much opportunity to discuss or disagree. In contrast, the both groups in the second round suggested that there was plenty of opportunity to disagree. As a result, the group spent considerable time reflecting on their decision-making process and how to reach consensus. Members of these two groups stated that while they did not always agree with the decisions made, they agreed with the democratic process used to select solutions -- as long as everyone had the opportunity to voice an opinion.

All four groups in the first round and the non-blended group in the second round reported that they were comfortable playing with the other players. However, this was expected since the participants were well-acquainted classmates. We anticipated that when conducting the study with Danish university students and professionals who were strangers, players would be less comfortable with each other, which could impact players’ willingness to suggest riskier solutions. Despite being strangers, the participants in the “blended” second round pilot test became acquainted quickly and felt comfortable with their group members.

RESULTS AND ANALYSIS

The following questions concerning the camera and filming were the most useful interview questions. These questions helped elucidate whether or not our hypothesis about surveillance was supported.

Was the camera distracting?

Three out of four groups of the first round indicated that the camera was distracting during gameplay. For both the “blended” and non-blended groups, players looked directly at, or spoke to the camera. In the “blended” groups, players indicated that because they were able to see themselves while being recorded, they were self-conscious about their appearance. While reviewing gameplay footage, we could see players adjusting their posture or appearance and looking directly at the camera as shown in Figure 16.



Figure 16: Camera Distracts Players

RESULTS AND ANALYSIS

One player of the “blended” version stated that because they were filmed “I changed how I sat.” Figure 17 shows that this player moved her chair so she did not directly face the camera.

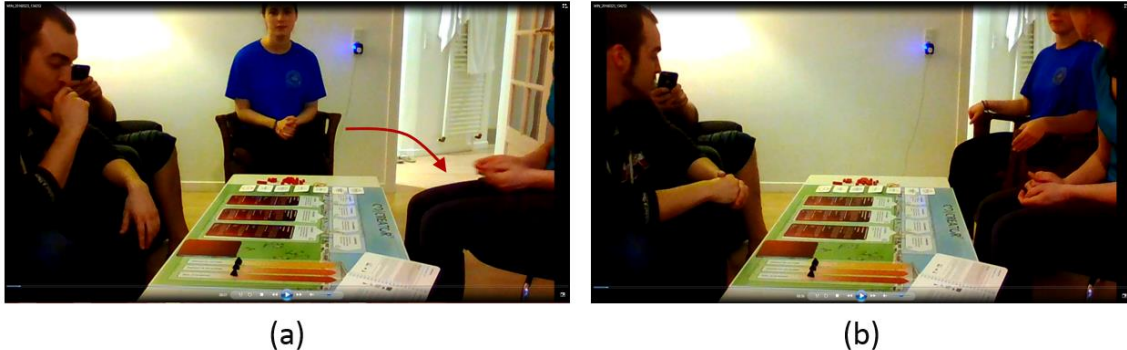


Figure 17: (a) Player's Initial Position (b) Player's Final Position

One group suggested that this resulted in “a less comfortable experience.” Another group recommended that we angle the camera more towards the game board and less at the players to make the participants more comfortable. This group also indicated that the camera may have been more distracting if someone other than their peers reviewed the footage. In the second round of pilot tests, both the non-blended and “blended” group unanimously agreed that the camera was not distracting at all and that they were too involved in the game to notice.

These results suggest that our study may be biased because groups playing both the non-blended and “blended” versions of *Co-Creator* were influenced by the presence of the video camera. In fact, the only way to properly represent the influence of surveillance on a player’s behavior would be through a hidden camera. However, due to ethical standards and the associated logistical complications of this setup, this is not a feasible solution. Unfortunately, there is no way to ensure that non-blended and “blended” set-ups are accurate representations of an original and digitally augmented version of a board game because we have no blended prototype to use as a comparison.

RESULTS AND ANALYSIS

Did knowing that you were being filmed impact the decisions you made? If so, how?

Although three groups stated that the camera impacted their comfort-level and caused distraction, all six groups contended that the camera did not impact the decisions they made. For example, one player stated, “I could [not] care less if the camera was there.” This suggests, in contrast to the results of the video observations, that our hypothesis is incorrect; the addition of surveillance through blending a board game does not impact players’ decision-making and behavior. However, this could indicate that players simply *perceived* that their actions were not impacted by surveillance. Contrary to what the test groups indicated, the presence of the camera affected the players. At the start of play, one group nearly cheated by looking at the outcome of the solutions prior to selecting one. After realizing that the group almost accidentally cheated, one player exclaimed, jokingly, “turn the camera off!” This indicates that the player would have been ashamed or embarrassed had they been caught cheating by the camera. Another group stated, that the presence of the camera prevented them from cheating. A third group suggested that the presence of the camera caused them to censor what they said during gameplay, thereby impacting their behavior and decision-making process.

For “blended” groups only: Did knowing that your moves were being tracked impact the decisions you made? If so, how? Do you think that it influenced whether or not you chose riskier cards?

Players of the “blended” version of *Co-Creator*, in both pilot testing rounds, reported that knowing their moves were being recorded did not influence their decision-making processes. One player said, “it didn’t influence my decisions at all” and another said, “regardless, I would have wanted to take risks.” A third player stated, “our final score reflects our every move already so it didn’t really change anything” and that “I don’t think [having our moves tracked] ever entered my mind”

RESULTS AND ANALYSIS

During the interview, several players of the “blended” groups, for both testing rounds, indicated that they cared less about their gameplay decisions because their peers were watching the footage as opposed to an authority figure. One player of stated that the “camera didn’t impact my decision making because I knew who was watching me. If a professor were watching me, eh, maybe.” Another player said, “I knew my peers were watching me so I didn’t care as much.” A third player claimed, “I didn’t think my boss was watching me so it didn’t really matter to me.” A fourth player stated that the effects of filming on their decisions “might be different if your boss is filming you while you’re doing this. I really don’t care. I could imagine that for other people in other settings it might matter.”

Several players suggested that if an authoritative figure such as their employer, an employee of Gametools, or professor reviewed the footage, they would care more about the choices made during the game. This is important because it suggests that although the blending of the game itself does not impact players’ behavior and actions, the context of the game- who facilitates the game and reviews the data collected- does have an impact. Therefore, to improve the introduction to the “blended” version of the game, we would tell participants that an authoritative figure will review the footage of gameplay to better replicate the surveillance caused by adding data tracking and handling to a board game.

On a scale of 1 to 5, how easy was it to identify which solution would give you positive or negative results (1=easy, 5=difficult to discern). Can you explain your ranking?

The responses to this question ensured that the “best” solutions on the cards were not so obvious as to inherently impact riskiness. Both a “blended” and two non-blended groups gave a value of “3”, indicating that it was neither very easy nor very difficult to determine which solutions would give the best and worst results. These three groups contended that it was sometimes difficult to know which solution was the best option and that some seemingly bad solutions gave very positive results, or results that contradicted with their experiences.

RESULTS AND ANALYSIS

One group who gave a value of “4” said that there was often a solution with an unexpected outcome and that the best solution, in terms of score, did not seem like a good idea. In the “blended” group from the second round of pilot tests, members gave both a “4” and “5” to this question because they had a difficult time determining which solution would be most beneficial.

During the second round of tests, one player commented that there was a flaw in this question because most solutions had both positive and negative outcomes. In another instance, when one researcher asked this question, a group responded with “4” before being told that 1 was the easiest and 5 was the hardest. Although they responded “4,” their explanation indicated that it was easy for them to determine which solutions would give positive or negative results. This group had said earlier in the interview that “The wording of the card gave away where you could get points.”

OBJECTIVE 2: RESULTS OF ANALYZING THE IMPACTS OF SURVEILLANCE

In the following statistical analysis, all tests used an alpha level, or significance level, of 0.05. An alpha level of 0.05 signifies that if the p-value is less than 0.05, the test is 95% confident that there is a difference in means. In other words, there is a 5% probability that the difference in means is due to chance (Frost, 2015).

When interpreting our data for the F-test (test for the equality of variances), if the p-value was less than 0.05, there was evidence to reject the null hypothesis of equal variances, indicating that the variances were unequal. If the p-value was greater than or equal to 0.05, the null hypothesis failed to be rejected and equal variance was accepted. The F-test was used to decide which t-test should be used— assuming equal variances or assuming unequal variances.

Similarly, when we interpreted our data for the t-test, if the p-value was less than 0.05, there was evidence to reject the null hypothesis of equal means (mean difference of 0 was

RESULTS AND ANALYSIS

assumed on all), indicating that there was a difference in means. If the p-value was greater than or equal to 0.05, the null hypothesis failed to be rejected and equal means were accepted. Simply stated, for a p-value greater than or equal to 0.05, the difference in values is not significant enough to be interpreted as a meaningful difference.

Gameplay Data

The following results were analyzed using the random data generated in the Java program. All information is random and is meant to be used only as a model of how to interpret the data in an actual study using these methods.

Risk Score of Groups' Solutions

Using the standard risk score we developed from the pilot test, we assigned overall average risk scores to each computer-simulated group. The overall average risk score reports how risky a team's choices were. Comparing the overall average risk score for the "blended" and non-blended versions identifies if riskiness has been impacted by surveillance.

Based on the "F-Test Two-Sample for Variances," the F value of 1.44 and p-value of 0.28 indicated that there was not a statistically significant difference in the variances. Since there was not enough evidence to prove that the variances were unequal, we used the "Two-Sample Assuming Equal Variances t-Test."

The mean score for the "blended" group (M= 1.936, SD= 0.178, N= 12) was not significantly different from the non-blended group (M= 1.937, SD= 0.148, N=12) when analyzed using the two-sample t-test for equal variances ($t_{Stat(22)} = -0.015$, p-value= 0.988).

As expected with using random data, the means are nearly the same. Since the means for the "blended" and non-blended group were not significantly different, this denotes that surveillance does not impact the overall riskiness of the decisions that the participants choose. This would be a positive result because Gametools wants their educational games to maintain their risk-free environment even when using a blended version.

RESULTS AND ANALYSIS

Resource Fraction T-Test

Since using a higher overall fraction of resources is riskier than using a lower fraction of resources, we looked at the average fraction of resource cards used per resources available throughout the entire game for each group. We considered this to see if one version, “blended” or non-blended, had a significantly higher average resource fraction (indicating higher risk) than the other.

Based on the “F-Test Two-Sample for Variances,” the F value of 1.82 and p-value of 0.168 indicated that there was not a statistically significant difference in the variances. Since there was not enough evidence to prove that the variances were unequal, we used the “Two-Sample Assuming Equal Variances t-Test.”

The mean score for the “blended” group (M= 0.593, SD= 0.083, N= 12) was not significantly different from the non-blended group (M= 0.618, SD= 0.062, N=12) when analyzed using the two-sample t-test for equal variances ($t_{Stat(22)} = -0.824$, p-value= 0.419).

There was not a significant difference in the average fraction of resources taken for the “blended” and non-blended group. This indicates that surveillance does not impact player’s willingness to use a high percentage of a resource to pay for a solution. Further, it negates our hypothesis that one group may be more inclined to use an “all-in” mentality. This would be a positive result because Gametools wishes to see no or minimal impact on gameplay behavior.

Delay Card T-Test

Delay cards can be used in the place of depleted resources or accrued as consequences of decisions. However, there are penalties at the end of the game for using and accruing them. Thus, Delay cards are thought of as risky. We considered the number of Delay cards used to decipher if there was a significant difference in the number used between versions.

RESULTS AND ANALYSIS

Based on the “F-Test Two-Sample for Variances,” the F value of 0.885 and p-value of 0.422 indicated that there was not a statistically significant difference in the variances. Since there was not enough evidence to prove that the variances were unequal, we used the “Two-Sample Assuming Equal Variances t-Test.”

The mean score for the "blended" group (M= 3.167, SD= 0.937, N= 12) was not significantly different from the non-blended group (M= 3.917, SD= 0.996, N=12) when analyzed using the two-sample t-test for equal variances (t Stat(22)= -1.899, p-value= 0.071).

When analyzing the Delay cards with real gameplay data, we would exclude the involuntary Delay cards. However, for this random scenario, we were unable to distinguish between the two types of Delays in the computer program output. Since the averages are not considered significantly different, this would be considered a positive result. The Delay card t-test proves that surveillance has not affected how many delay cards players use or receive in the game. It could also be important to note as a reference that this test was by far the closest to being significantly different with a p-value of 0.07.

Game Score T-Test

We evaluated the final game score for each group to see if there was a significant difference in scores between the two versions. A difference in game score would indicate that surveillance impacts gameplay decisions and behavior.

Based on the “F-Test Two-Sample for Variances,” the F value of 0.505 and p-value of 0.136 indicated that there was not a statistically significant difference in the variances. Since there was not enough evidence to prove that the variances were unequal, we used the “Two-Sample Assuming Equal Variances t-Test.”

The mean score for the "blended" group (M= 4.083, SD= 0.900, N= 12) was not significantly different from the non-blended group (M= 4.167, SD= 1.267, N=12) when analyzed using the two-sample t-test for equal variances (t Stat(22)= -0.186, p-value= 0.854).

RESULTS AND ANALYSIS

Due to the game score being a culmination of decisions throughout the entire game, the game score averages do not necessarily mean that surveillance had any effect. However, we thought it would be interesting to look at for correlations, patterns, and to see if there were any differences in the final game score in general. The data could potentially indicate that one version received better scores than the other version in future studies. In our case, the lack of significantly different results indicated that there was not a difference in overall game score between the “blended” and non-blended group. This is a positive result because it proves that overall gameplay is not affected by surveillance, and similar game scores are achieved in either version.

The following Table 3 summarizes the Risk Score, Resources, Delay, and Game Score t-Test results for the computer-generated random data.

Table 3: Risk Score, Resource Fraction, Delay, Game Score Results

Risk Score, Resource Fraction, Delay, Game Score Results						
		Mean	St. Dev. (±)	Degrees of Freedom	t Stat	p-Value
Risk Score	"Blended"	1.936	0.178	22	-0.015	0.988
	Non-Blended	1.937	0.148			
Resources	"Blended"	0.593	0.083	22	-0.824	0.419
	Non-Blended	0.618	0.062			
Delay	"Blended"	3.167	0.937	22	-1.899	0.071
	Non-Blended	3.917	0.996			
Game Score	"Blended"	4.083	0.900	22	-0.186	0.854
	Non-Blended	4.167	1.267			

RESULTS AND ANALYSIS

Questionnaire

The analysis on the questionnaire uses the first round of pilot tests, which were performed on WPI students. While the data has undergone statistical analysis and conclusions have been drawn, it should be noted that the students understood the purpose of the study prior to testing and are a biased group.

Questionnaire: Likert Scale T-Test for WPI Students

From the questionnaire, we looked at the following Likert scale groups: Presence, Immersion, Flow, Absorption, Psychological Involvement – Empathy, Psychological Empathy – Negative Feelings, and Behavioral Engagement. The analysis for each group, based on the WPI pilot tests, is explored below.

Presence

Presence can be described as “being in a normal state of consciousness and having the experience of being inside a virtual environment” (Brockmyer et al., 2009, p. 624-625). This means that players are aware and active participants in the game environment.

Based on the “F-Test Two-Sample for Variances,” the F value of 1.64 and p-value of 0.24 indicated that there was not a statistically significant difference in the variances. Since there was not enough evidence to prove that the variances were unequal, we used the “Two-Sample Assuming Equal Variances t-Test” in Excel. Two-sample test is another way to express that the groups being compared are unpaired.

The mean score for the "blended" group (M= 2.3, SD= 0.597, N= 10) was not significantly different from the non-blended group (M= 2.067, SD= 0.466, N=10) when analyzed using the two-sample t-test for equal variances (t Stat(18)= 0.974, p-value= 0.343).

RESULTS AND ANALYSIS

Immersion

Immersion “describes the experience of becoming engaged in the game-playing experience while retaining some awareness of one’s surroundings” (Brockmyer et al., 2009, p. 624).

Based on the “F-Test Two-Sample for Variances,” the F value of 1.69 and p-value of 0.22 indicated that there was not a statistically significant difference in the variances. Since there was not enough evidence to prove that the variances were unequal, we used the “Two-Sample Assuming Equal Variances t-Test.”

The mean score for the "blended" group (M= 2.9, SD= 0.699, N= 10) was not significantly different from the non-blended group (M= 3.2, SD= 0.537, N=10) when analyzed using the two-sample t-test for equal variances (t Stat(18)= -1.076, p-value= 0.296).

Absorption

Absorption reports the “total engagement in the present experience” (Brockmyer et al., 2009, p. 625).

Based on the “F-Test Two-Sample for Variances,” the F value of 2.97 and p-value of 0.06 indicated that there was not a statistically significant difference in the variances. The p-value of 0.06 was extremely close to being within the 0.05 range indicating a statistically significant difference in variances, which would have allowed for the “Two-Sample Assuming Unequal Variances t-Test” to be utilized. However, since there was not enough evidence to prove that the variances were unequal, we used the “Two-Sample Assuming Equal Variances t-Test.”

The mean score for the "blended" group (M= 2.8, SD= 0.757, N= 10) was not significantly different from the non-blended group (M= 2.733, SD= 0.439, N=10) when analyzed using the two-sample t-test for equal variances (t Stat(18)= 0.241, p-value= 0.812).

RESULTS AND ANALYSIS

Flow

Flow explains the “feelings of enjoyment that occur when a balance between skill and challenge is achieved in the process of performing an intrinsically rewarding activity” (Brockmyer et al., 2009, p. 625). This describes the pleasure people feel when they have the opportunity to use their skills, but are not overwhelmed by the challenges presented.

Based on the “F-Test Two-Sample for Variances,” the F value of 2.58 and p-value of 0.09 indicated that there was not a statistically significant difference in the variances. Since there was not enough evidence to prove that the variances were unequal, we used the “Two-Sample Assuming Equal Variances t-Test.”

The mean score for the "blended" group (M= 2.690, SD= 0.538, N= 10) was not significantly different from the non-blended group (M= 2.488, SD= 0.335, N=10) when analyzed using the two-sample t-test for equal variances (t Stat(18)= 1.009, p-value= 0.326).

PI – Empathy

Psychological Involvement - Empathy measures “positive feelings of togetherness (enjoyment of social context, connectedness, empathy, sympathy, and admiration)” (De Kort et al., 2007, p. 4).

Based on the “F-Test Two-Sample for Variances,” the F value of 1.06 and p-value of 0.46 indicated that there was not a statistically significant difference in the variances. Since there was not enough evidence to prove that the variances were unequal, we used the “Two-Sample Assuming Equal Variances t-Test.”

The mean score for the "blended" group (M= 3.443, SD= 0.569, N= 10) was not significantly different from the non-blended group (M= 3.514, SD= 0.552, N=10) when analyzed using the two-sample t-test for equal variances (t Stat(18)= -0.285, p-value= 0.779).

RESULTS AND ANALYSIS

PI – Negative feelings

Psychological Involvement - Negative Feelings describes “negatively toned emotions (jealousy, revenge, schadenfreude or malicious delight)” (De Kort et al., 2007, p. 4).

Based on the “F-Test Two-Sample for Variances,” the F value of 1.0 and p-value of 0.498 indicated that there was not a statistically significant difference in the variances. Since there was not enough evidence to prove that the variances were unequal, we used the “Two-Sample Assuming Equal Variances t-Test.”

The mean score for the "blended" group (M= 2.357, SD= 0.518, N= 10) was not significantly different from the non-blended group (M= 2, SD= 0.517, N=10) when analyzed using the two-sample t-test for equal variances (t Stat(18)= 1.542, p-value= 0.140).

Behavioral Engagement

Behavioral Involvement (Engagement) measures “the degree to which players feel their actions to be dependent on their co-player's actions” (De Kort et al., 2007, p. 7).

Based on the “F-Test Two-Sample for Variances,” the F value of 1.610 and p-value of 0.244 indicated that there was not a statistically significant difference in the variances. Since there was not enough evidence to prove that the variances were unequal, we used the “Two-Sample Assuming Equal Variances t-Test.”

The mean score for the "blended" group (M= 3.038, SD= 0.510, N= 10) was not significantly different from the non-blended group (M= 3.359, SD= 0.402, N=10) when analyzed using the two-sample t-test for equal variances (t Stat(18)= -1.564, p-value= 0.135).

Overview

Based on the analysis of the Likert groups (Presence, Immersion, Flow, Absorption, Psychological Involvement – Empathy, Psychological Empathy – Negative Feelings, and Behavioral Engagement), the results indicated that none of the groups had statistically significant differences in means. All of the p-values were greater than the significance level of

RESULTS AND ANALYSIS

0.05. These results identify that the WPI students playing the “blended” version and the non-blended version did not have differing feelings or gameplay experiences in each of the Likert groups. This strongly supports Gametools’ hope that integrating digital technology for movement tracking will not have an impact on personal experience, social interactions, and overall gameplay experience. A summarized table of the t-test results can be seen below in Table 4.

Table 4: Questionnaire: Likert Scale for WPI Students Results

Questionnaire: Likert Scale for WPI Students Results						
		Mean	St. Dev. (±)	Degrees of Freedom	t Stat	p-Value
Presence	"Blended"	2.300	0.597	18	0.974	0.343
	Non-Blended	2.067	0.466			
Immersion	"Blended"	2.900	0.699	18	-1.076	0.296
	Non-Blended	3.200	0.537			
Absorption	"Blended"	2.800	0.757	18	0.241	0.812
	Non-Blended	2.733	0.439			
Flow	"Blended"	2.690	0.538	18	1.009	0.326
	Non-Blended	2.488	0.335			
PI - Empathy	"Blended"	3.443	0.569	18	-0.285	0.779
	Non-Blended	3.514	0.552			
PI - Negative Feelings	"Blended"	2.357	0.518	18	1.542	0.140
	Non-Blended	2.000	0.517			
Behavioral Engagement	"Blended"	3.038	0.510	18	-1.564	0.135
	Non-Blended	3.359	0.402			

RESULTS AND ANALYSIS

Questionnaire: Likert-type for WPI Students

The Likert-type questions (38-42) were asked as potential questions for Gametools to use in a future feedback survey. The responses, based on the WPI pilot tests, have been analyzed below as frequency, frequency percentages, median, and mode(s).

Overall, questions 38, 39, and 40 were geared towards understanding if *Co-Creator* presented a good learning environment and if the material learned could be applied by the participants in real-life. Question 41 was a logistical question about the game's ease of use. Lastly, question 42 was aimed at understanding the overall value of the game to the player and if he or she would recommend the game.

The frequency percentages for each Likert-type question are show in Figures 18-22 and the frequency breakdowns can be found in Appendix P. Both the frequency percentages and frequency breakdowns represent the number of times a score (1-strongly disagree to 5-strongly agree) was chosen for a particular item. For the results, we used the frequency percentages since they are easier to comprehend outside of context than a count.

38. *Co-Creator presented a risk-free environment to make innovation decisions.*

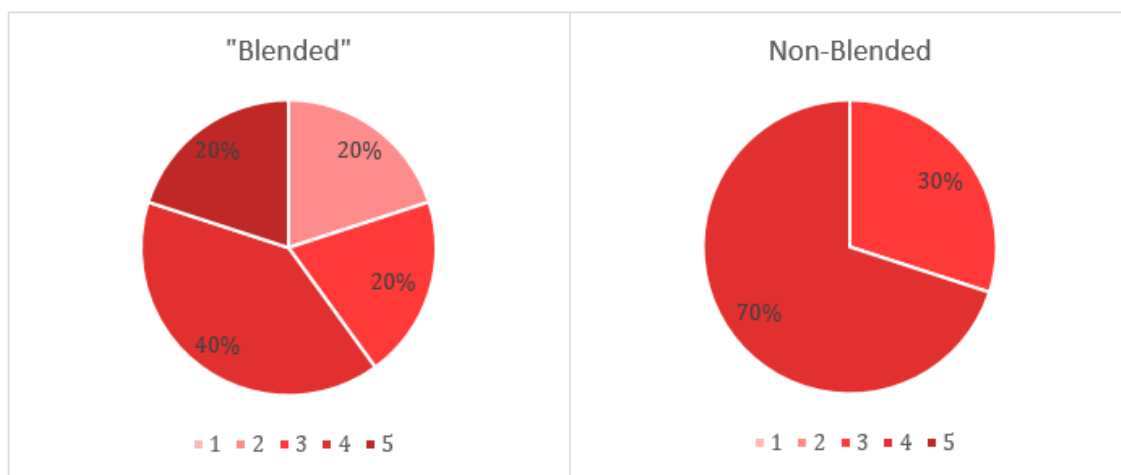


Figure 18: Question 38 Likert-Type Responses

RESULTS AND ANALYSIS

For question 38, 70% of the non-blended responses indicated a score of 4 (Agree), while only 60% of the “blended” group indicated a score of 4 or 5 (Agree, Strongly Agree). The non-blended responses did not contain any scores of 1 or 2 (Strongly Disagree, Disagree) with the remaining 30% responding with a 3 (Neither Agree nor Disagree). The “blended” responses did not contain any scores of 1, but 20% did identify with a score of 2 and also with 3. These results lean towards the non-blended group feeling as though they are in a more risk-free environment.

39. I understand consequences of innovative decisions now.

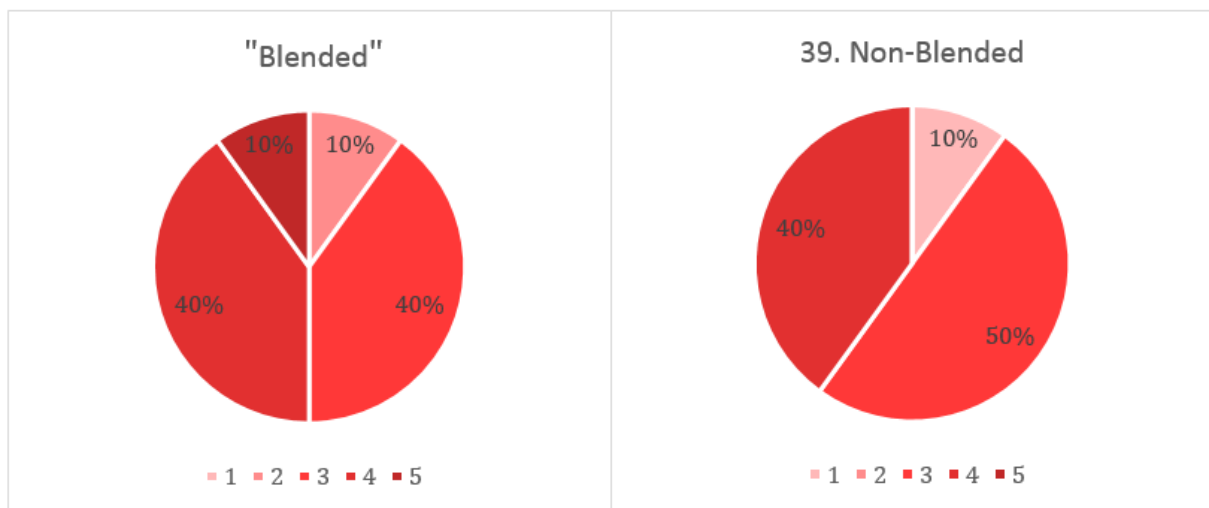


Figure 19: Question 39 Likert-type Responses

For question 39, 50% of the “blended” group answered with a score of 4 or 5, with the next largest margin of 40% answering with a score of 3. 40% of the non-blended group answered with a score of 4, with the most responses, 50%, responding neutrally at a score of 3. Based on these responses, most participants felt neutral or slightly agreed that they understood the consequences of innovative decisions after playing *Co-Creator*. With this type of question, comparisons between the two groups could not be concluded further.

RESULTS AND ANALYSIS

40. I will use strategies presented in *Co-Creator* in future decisions.

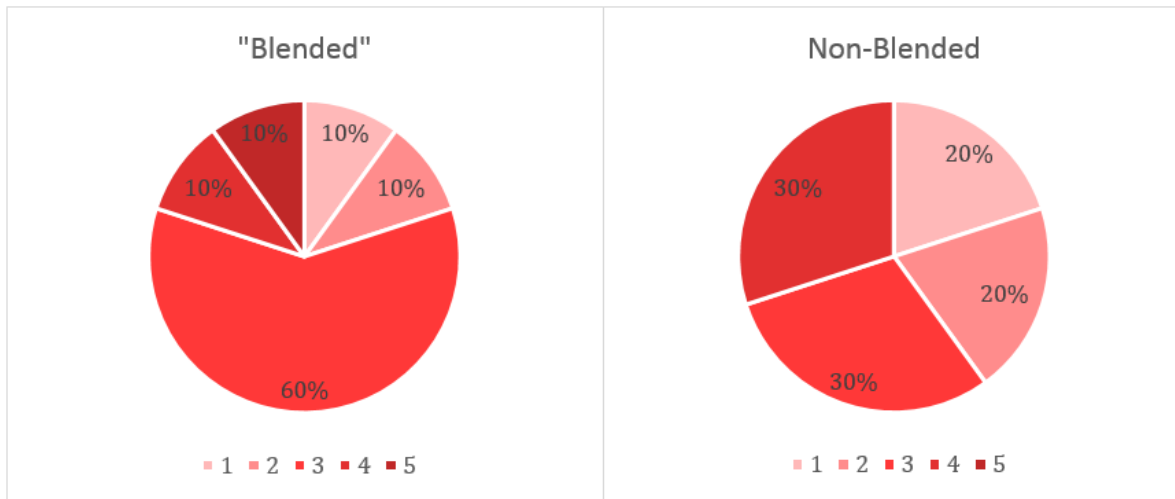


Figure 20: Question 40 Likert-Type Responses

For question 40, 20% of the “blended” group chose a score of 1 or 2, while 40% of the non-blended group chose a score of 1 or 2. 60% of the “blended” group responded with a score of 3, describing that they were neutral, while only 30% of non-blended felt neutral with a score of 3. Due to the opinionated nature of the question asked, no comparisons or conclusions between the groups can be made. A worthwhile note would be that the results were most likely a reflection on the participants used. Since they were not business professionals, it was difficult for them to either decide on or agree with using the strategies presented in *Co-Creator* in future decisions.

RESULTS AND ANALYSIS

41. *The game was easy to navigate/the instructions were clear.*

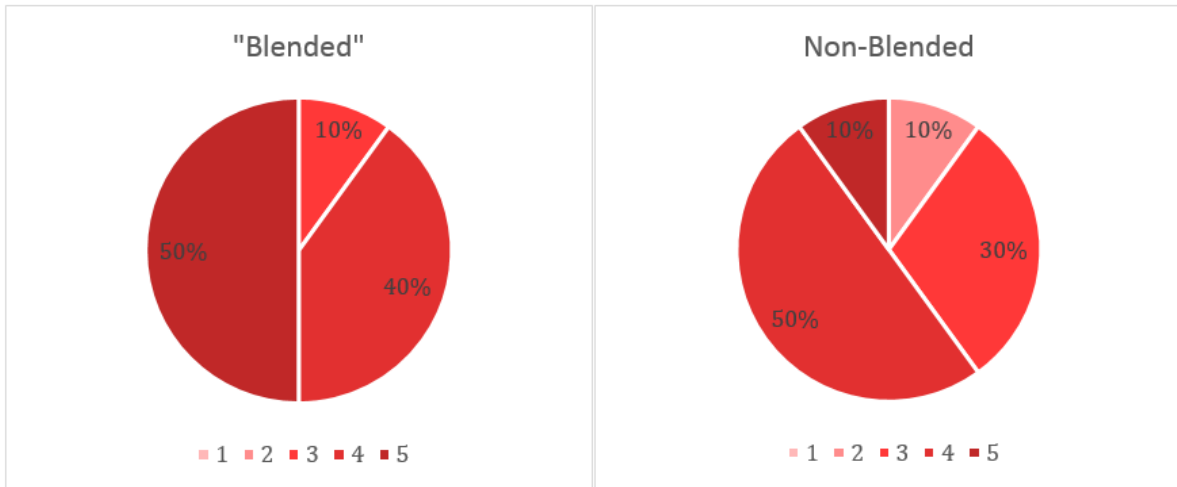


Figure 21: Question 41 Likert-Type Responses

For question 41, 90% of the “blended” group answered with a score of 4 or 5. Only 60% of the non-blended group answered with a score of 4 or 5. This question was also dependent on the players and their understanding of the game mechanics provided by the manual. Since the manual was the same for both groups, no results or comparisons can be concluded between the two groups.

RESULTS AND ANALYSIS

42. *I would recommend Co-Creator to my colleagues.*

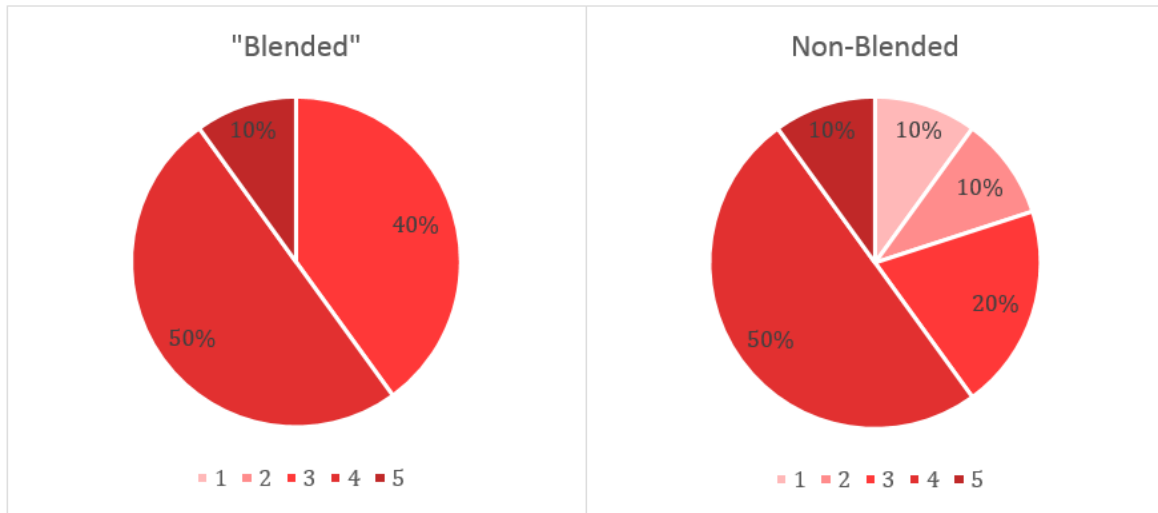


Figure 22: Question 42 Likert-type Responses

For question 42, 60% of both the “blended” group and the non-blended group chose a score of 4 or 5. These results indicate that both the “blended” and non-blended groups would recommend *Co-Creator* to friends and colleagues.

The median, which pinpoints the middle value chosen, and mode(s), which describes which score was chosen the most, are shown in Tables 5 and 6 for “blended” and non-blended respectively.

The median and mode are good references for quickly seeing what choices were popular. Both the “blended” and non-blended median and mode(s) stay in the range of 3 and 4 with a couple of high outliers in the “blended” version. In general, the numbers are neutral or positive. 3 (Neither Agree nor Disagree) indicates that the participants were neutral about the question, which is not necessarily positive or negative. 4 (Agree) indicates that the participant agreed with the question which is a positive response.

RESULTS AND ANALYSIS

Table 5: "Blended" Likert-type Median & Mode

"Blended" Median & Mode					
	Question #				
	38	39	40	41	42
Median	4	3.5	3	4.5	4
Mode	4	3,4	3	5	4

Table 6: Non-Blended Likert-type Median & Mode

Non-Blended Median & Mode					
	Question #				
	38	39	40	41	42
Median	4	3	3	4	4
Mode	4	3	3,4	4	4

CONCLUSIONS AND RECOMMENDATIONS

Conclusions and Recommendations

The initial goal of the project was to determine if the addition of surveillance, in the form of data mining and game piece tracking, significantly altered the gameplay of Gametools' business board game *Change Navigator*. However, at the time of our study, the blended prototype of *Change Navigator* had not yet been produced. To overcome this limitation, we used two different game configurations to simulate the non-blended and blended versions of a similar and simpler business game, *Co-Creator*, also created by Gametools.

We successfully developed a method to analyze the differences in players' behavior, decisions, social interaction, and personal experience while playing "blended" and non-blended business board games. This method, which is valid for both *Co-Creator* and *Change Navigator*, combined three frequently used methods: video observations, questionnaires, and group interviews. We pilot tested our method on a convenience sample of 20 university students from Worcester Polytechnic Institute (WPI). We then revised our method and conducted an additional pilot test on a convenience sample of 10 Danish university students and business professionals. Pilot testing our method demonstrated that our methods for filming, interviewing, and data collection were logistically feasible and yielded useful data. After this, we generated random data of simulated board game runs to test and polish our statistical methods. This provided Gametools with the framework for statistically analyzing and interpreting the results of our method when implementing it in the future.

There were several limitations to our methods. The first limitation was that when using these methods, we cannot be certain that the "blended" version of the game accurately simulates a blended business game. The second, and common ethnographic dilemma, is that we needed to surveil people in a context where they should not be observed. In our configuration for the non-blended tests, we made observations as unobtrusive as possible. Further, this problem might be less relevant for *Change Navigator* because a facilitator is

CONCLUSIONS AND RECOMMENDATIONS

already present and causing surveillance during gameplay, regardless of whether or not the game is blended.

We hypothesized that the addition of surveillance in educational business board games would detract from a player's ability to make risky decisions. While this project did not receive enough participants to statistically suggest whether or not the hypothesis was supported, it did set the groundwork to continue testing and eventually determine if the hypothesis is supported.

The questionnaire supported Gametools' hope that integrating digital technology into business board games will not have an impact on personal experience, social interactions, and overall gameplay experience. Anecdotal information collected during our interviews also suggested that our hypothesis was incorrect; surveillance in business board games is seemingly inconsequential. During the interview, while some players indicated that the presence of the camera was distracting, all players contended that the presence of the camera and recording of their moves did not impact their decisions or behavior. *However, what people say they feel and contend that they would do does not always align with what they actually do.* This may explain why, even though all groups reported that the presence of the camera did not impact their decisions, the data collected from our video observations supported our hypothesis. For example, the resource fraction and the riskiness of solutions selected by the non-blended group was higher than the "blended" group, which indicates riskier decision-making by the non-blended group. Similarly, one group said they were not impacted by the camera but felt embarrassed when they were almost caught cheating.

Groups also consistently reported that had someone with greater authority such as an employer or professor reviewed footage of play, their decisions may have been impacted. *Therefore, the making of the blended game itself does not impact how players experience and play the game, but the context of the game- how the facilitator frames the game and who is reviewing the data collected – is extremely influential on player's behavior.* This is important to

CONCLUSIONS AND RECOMMENDATIONS

consider because Gametools is hoping to market *Change Navigator* for big data collection and compare data from one session of play to another. Any issues with influencing player behavior through varying game context could be rectified through a consistent method of briefing players, framing the game, and facilitating. However, this may impact the marketability of *Change Navigator* since a primary selling feature of the game is that the consultancy agency using *Change Navigator* can customize the game to meet their needs.

When Gametools implements our method to compare the original non-blended and blended version of *Change Navigator*, we recommend the following:

The facilitator and person reviewing gameplay data should be a figure of authority. In all six test groups, participants contended that the camera did not have any effect on their decision-making process. However, several participants suggested that if an authority figure, such as a boss or professor, were going to watch the film, then they may have acted differently. If the blended *Change Navigator* was played by the employees of a company, their employer would review the data collected. Therefore, the players of the blended version should believe that an authoritative figure is reviewing gameplay footage to better represent the true environment in which the blended version would be used.

Create a pretense that the game results will be used to assess players' skills. Similar to using an authority figure, players of the blended version should believe that their skills are being evaluated. This is because the data collected while playing the blended version of *Change Navigator* may be used to assess companies, or even individuals. As our findings suggest, the perception of being evaluated may impact the riskiness of players' actions.

Test on players of an older generation. While the members of our study were of varying ages, from university age to professional age, we did not test on players older than

CONCLUSIONS AND RECOMMENDATIONS

Generation X. This would need to be addressed in further testing because those of older generations may not have the same attitude toward technology and surveillance as members of our generation do.

If performing the study using Change Navigator, allow players to play one or two rounds instead of all three. This reduces the time commitment, making it easier to recruit a larger pool of participants. Because Gametools' goal is to create a blended version of Change Navigator, it is important to test the effects of surveillance on that specific game. However, if the full game of *Change Navigator* is played, then participants will need to commit upwards of five hours for testing. Therefore, it is highly suggested to play only one or two rounds of the game because this will cut down on time while yielding the necessary results.

Begin recruiting universities, companies, and participants in general early and aggressively. If participants are not secured far in advance to testing dates, then it is very difficult to recruit players. In addition, recruiters should attempt several different methods of finding game testers because not every method of recruiting will reach the target population and overlapping methods will help to close this gap.

Eliminate the statements in the questionnaire that caused confusion and then revalidate the Likert scale items with a large enough sample size. A few statements in the questionnaire confused the participants due to the content and structure. We suggest removing these statements and revalidating the questionnaire so that the Likert scale groups represent the data correctly. This will ensure that the scale is giving reliable information.

Use a blended prototype of *Change Navigator* to conduct the study. There is no way to ensure that our "blended" configuration is an accurate representation of an actual blended prototype of *Co-Creator*. Therefore, to minimize confounding variables and unusable data when conducting this study, participants should play a blended prototype of Change Navigator.

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APPENDICES

Appendices

APPENDIX A: WRITTEN CONSENT FORM

Participation Form and Statement of Rights

We are students at Worcester Polytechnic Institute in Worcester, Massachusetts. We are conducting a research project on behalf of Gametools to determine how digitally augmenting games impacts players' experience. As part of this project we are conducting a series of gameplay, questionnaires, and interviews with students of various Universities. We have asked you to participate because we believe you have unique knowledge of this area that will be valuable to the project.

Before we begin, we would like to thank you for taking the time to participate in the gameplay, questionnaire, and interview which will last about one and a half hours. Your participation is entirely voluntary. You may refuse to discuss any question or terminate the process at any time. With your permission we would like to record the gameplay, questionnaire, and interview. The tapes, notes, and subsequent transcripts of the interview will be kept confidential, and will be accessible by only the members of the team and our immediate faculty advisors. Your name will not be used in any subsequent report or publication without your permission.

If you consent to gameplay, the questionnaire, and interviewing at this time, we would ask that you indicate your agreement below.

I agree to participate in the study above _____
Interviewee Signature _____ Date

Interviewee Name

Please initial for permission to record _____
Interviewee Initials

Interviewer Signature _____ Date

APPENDICES

APPENDIX B: CO-CREATOR PRE-PLAY INSTRUCTIONS

Co-Creator Pre-Play Instructions

Non-Blended Environment (Low Stress):

- Playing the game, Co-Creator
- Looking at usability of tokens on resource cards
- Have fun

Blended Environment (High Stress):

- Playing the game, Co-Creator
- Assessing skills
- Assessing ability to come up with innovative solutions in a group setting
- Assessing final score as well as decisions throughout the game
- Tracking game decisions and movements
- Winning the game in comparison to other groups playing will result in a prize

Additional Game Instruction:

- Playing Co-Creator should take approximately 1-1.5 hours
- Carefully read through instructions while playing
- Skip all of the sections labeled “Back to Reality” in the instruction manual (in Phase 3,5,7)
- For ease of use, please use tokens to mark how much of each resource you have. When you need to take a resource from the bank, place a token on the corresponding resource card instead of taking a new card as the manual instructs.
- As our sponsor wants the games to be stored in a certain way, please leave everything where it is when you finish playing. No clean up required.
- Any questions?

APPENDICES

APPENDIX C: CO-CREATOR GAMEPLAY TRACKING SHEET

Gameplay Tracking Sheet

Date _____ / _____ / _____ Group # _____ Circle one: Non-blended Blended

Phase 2: Initiator

Challenge 1: _____

Challenge 2: _____

Challenge 3: _____

Time to Complete Phase: _____ min

Resource	Challenge 1: Common Starting Point		Challenge 2: Workflows		Challenge 3: Kick-Off Event	
	Price	Available Resources	Price	Available Resources	Price	Available Resources
Finances						
Network						
Legwork						
Professional Expertise						
Mandate						
Commitment						
Delay						
Delay as Resource						

APPENDICES

Score	Challenge 1: Common Starting Point	Challenge 2: Workflows	Challenge 3: Kick-Off Event
Innovative Culture			
Innovative Solutions			
Goal Attainment			

Phase 4: Facilitator

Challenge 1: _____

Challenge 2: _____

Challenge 3: _____

Time to Complete Phase: _____ min

Resource	Challenge 1: Different Agendas		Challenge 2: Decision- Making Powers		Challenge 3: Local Opposition	
	Price	Available Resources	Price	Available Resources	Price	Available Resources
Finances						
Network						
Legwork						
Professional Expertise						
Mandate						
Commitment						
Delay						
Delay as Resource						

APPENDICES

Score	Challenge 1: Different Agendas	Challenge 2: Decision- Making Powers	Challenge 3: Local Opposition
Innovative Culture			
Innovative Solutions			
Goal Attainment			

APPENDICES

Phase 6: Catalyst

Challenge 1: _____

Challenge 2: _____

Challenge 3: _____

Time to Complete Phase: _____ min

Resource	Challenge 1: Eye Opener		Challenge 2: Risk Aversion		Challenge 3: Future Life of the Project	
	Price	Available Resources	Price	Available Resources	Price	Available Resources
Finances						
Network						
Legwork						
Professional Expertise						
Mandate						
Commitment						
Delay						
Delay as Resource						

Score	Challenge 1: Eye Opener	Challenge 2: Risk Aversion	Challenge 3: Future Life of the Project	Pre Final Score	Total Delays	Final Score
Innovative Culture						
Innovative Solutions						
Goal Attainment						

APPENDICES

APPENDIX D: CO-CREATOR RISK RANKING OF CHALLENGES

Riskiness of Solutions

Instructions: Within the following groups, rank the solutions A, B and C from 1-lowest riskiness to 3-highest riskiness. Write your rank in the right-hand column.

Initiator 1: Common Starting Point	Riskiness Rank
<p>Challenge: You quickly realize that your diversity is not only a strength. The stakeholders' different backgrounds simply mean that they do not speak the same language, and that they have very different expectations as to the amount of time to be invested in the project. What will you do to ensure a common starting point?</p>	<p>1-Lowest 2-Medium 3-Highest</p>
<p>Solution A- Internal Staff Working Paper We will sit down with the members of the project group one at a time in order to align expectations. There are then compiled in an internal document, which will serve as a set of guidelines.</p> <p>Price: 1 Legwork 1 Commitment 1 Professional Expertise</p>	
<p>Solution B- Clear Mandate We obtain a mandate from the political leadership and hospital management, who clearly outline what the task consists of.</p> <p>Price: 2 Mandate</p>	
<p>Solution C- Common Narrative We hold a new joint meeting, where we try to create a common narrative for the project through games, mini-workshops, and forum theater.</p> <p>Price: 1 Commitment 1 Network</p>	

APPENDICES

<p>Initiator 2: Workflows</p> <p>Challenge: An important challenge is how to work on the project alongside existing operations. But you have to take into consideration that the members of the project group also have other work, and even a thing as simple as the venue for project meetings can turn into a problem. How will you assign workflows, and where will the work take place?</p>	<p>Riskiness Rank</p> <p>1-Lowest 2-Medium 3-Highest</p>
<p>Solution A- Staying with Operations</p> <p>We keep the project office in the department or at the health center. In this way, we gain a solid base close to day-to-day operations.</p> <p>Price: 2 Professional Expertise</p>	
<p>Solution B- Mobile Secretariat</p> <p>We make use of a mobile project office, where we alternate between the health center, the municipality, and the hospital. This ensures that the transportation cost is evenly distributed and that we regularly are close to the operations that are part of our work.</p> <p>Price: 1 Legwork 2 Professional Expertise</p>	
<p>Solution C- External Project Office</p> <p>We establish a project group in some pleasant office surroundings near the hospital. This guarantees peace to work on the project but also helps us to extract project group members from their usual setting and - hopefully- their usual thought patterns.</p> <p>Price: 1 Commitment 2 Finance</p>	

APPENDICES

<p>Initiator 3: Kick-Off Event</p> <p>Challenge: You have now reached the point where you are going to present the project. You want to ensure that the employees in the department and at the health center are properly informed, but you would also like ordinary citizens to be informed about the project. How will you go about this?</p>	<p>Riskiness Rank</p> <p>1-Lowest 2-Medium 3-Highest</p>
<p>Solution A- Seminar</p> <p>We hold an open seminar at the hospital with the stakeholders, where we present the project and the stakeholders' roles in the project. We invite the press, employees, and citizens to come. In this way, the project will be introduced to the public, but in a way that ensures that both the project group and stakeholders maintain ownership.</p> <p>Price:</p> <ul style="list-style-type: none"> 1 Commitment 1 Professional Expertise 1 Network 	
<p>Solution B- Town Hall Meeting</p> <p>We organize a town hall meeting in a community. The focus is on telemedicine broadly, and we encourage citizens to voice their opinions and suggestions We make sure to select patient groups to invite to the meeting.</p> <p>If you have the Danish Heart Association as a stakeholder the cost of this solution is only 2 legwork.</p> <p>Price:</p> <ul style="list-style-type: none"> 2 Legwork 2 Network 	
<p>Solution C- Workshop</p> <p>We present the project at an internal workshop, held at the health center, but where the involved employees from the hospital and municipality are invited. The primary emphasis is not just on informing the employees about the project but on making them feel part of it.</p> <p>Price:</p> <ul style="list-style-type: none"> 2 Commitment 	

APPENDICES

<p>Facilitator 1: Different Agendas</p> <p>Challenge: The members of the project group do not agree on where the project’s main emphasis should lay. Is evidence more important than rapid completion? And how large a role ought technology play? At the same time, you experience that individual project members begin using a harsh and irreconcilable tone - maybe because all of you come from different worlds. How will you resolve this?</p>	<p>Riskiness Rank</p> <p>1-Lowest 2-Medium 3-Highest</p>
<p>Solution A- External Consultant</p> <p>To ensure group cohesion, we think that input for changes to be made come from an external source. This is why we hire process consultants to guide us through the establishment phase.</p> <p>Price: 1 Professional Expertise 1 Finance</p>	
<p>Solution B- Field Trip</p> <p>We go on a joint field trip to a hospital in Germany, and which has experience with similar processes. We hope that this will give the group a positive and shared experience as well as a slew of new ideas.</p> <p>Price: 1 Legwork 1 Network 2 Finance</p>	
<p>Solution C- If You’re Not with Us...</p> <p>We cannot abide by project members who do not contribute. And instead of diluting the goal, we would rather sacrifice some of the breadth of the group. We involve management and secure a mandate to continue the project without the stakeholder whom we feel is moving things in the wrong direction.</p> <p>Price: 2 Mandate</p>	

APPENDICES

<p>Facilitator 2: Decision-Making Powers</p> <p>Challenge: You realize that elements of the project runs counter to the centralized purchasing policy. You will quite simply lack equipment for the project if you are to follow guidelines. How will you proceed from this point?</p>	<p>Riskiness Rank</p> <p>1-Lowest 2-Medium 3-Highest</p>
<p>Solution A- Customize the New Technology</p> <p>We convince the suppliers to alter the technology so that it is compatible with the extant equipment that we have at our disposal within our current framework.</p> <p>Price:</p> <ul style="list-style-type: none"> 1 Legwork 1 Professional Expertise 1 Finance 	
<p>Solution B- Dispensation</p> <p>We make a stand and try to get dispensation so that we can buy exactly the equipment that we need.</p> <p>Price:</p> <ul style="list-style-type: none"> 1 Mandate 1 Network 	
<p>Solution C- Breaking the Law</p> <p>We believe that we can define the development project as a more or less independent unit. The project's shape entails that we do now have to adhere to the same rules as everyone else. That is why we purchase the things we need outside of the centralized purchasing policy.</p> <p>You may only choose this solution if you have 4 Innovative Culture or 3 Innovative Solution.</p> <p>Crease their understanding of the project's potential.</p> <p>Price:</p> <ul style="list-style-type: none"> 1 Professional Expertise 2 Mandate 	

APPENDICES

<p>Facilitator 3: Local Opposition</p> <p>Challenge: The project causes the employees in the department and municipality to voice opposition. They feel that critical time is being reallocated from day-to-day operations, and they demand additional resources in order to meet the demands of both the project and operations. How will you respond to this challenge?</p>	<p>Riskiness Rank</p> <p>1-Lowest 2-Medium 3-Highest</p>
<p>Solution A- Involve the departments</p> <p>We reckon that deeper knowledge will motivate the staff. Therefore, we involve the affected departments even further in the project; both to defuse their criticism but also to increase their understanding of the project's potential.</p> <p>Price: 2 Legwork 1 Commitment 1 Professional Expertise</p>	
<p>Solution B- Focus on Operations</p> <p>We understand the criticism. We therefore strive to raise additional funds for the project so that normal operations are not neglected because of the project.</p> <p>Price: 2 Legwork Take 1 Delay from the bank.</p>	
<p>Solution C- The Hard-Line Approach</p> <p>We cannot tolerate internal resistance every time changes are decided. We therefore enlist management's help and have them take care of the opposition, and, if necessary, transfer them if they do not fall into line.</p> <p>Price: 1 Commitment 1 Professional Expertise 1 Mandate</p>	

APPENDICES

Catalyst 1: Eye Opener Challenge: A colleague, newly arrived home from a major conference, points out an approach that you have completely overlooked. This is the obvious way to proceed, and, in many ways, this approach is inefficient at achieving what you want, but this is just not what the project is currently about. How do you deal with this issue?	Riskiness Rank 1-Lowest 2-Medium 3-Highest
Solution A- All Ahead Our ideas are both solid and innovative, so we stick to the plan. But in order to ensure enthusiasm for the last phase, we organize a workshop over a weekend at a training center. The new setting can help us reflect and come up with fresh ideas, but the goal remains unchanged. Price: 1 Commitment 2 Finance	
Solution B- Reboot We take a step back and involve an extra stakeholder who possesses what you lack. It takes time but also ensures the projects group's commitment and that it arrives at the most innovative solution. Price: 2 Legwork 1 Network 1 Mandate	
Solution C- New Project: This is an obvious opportunity to become even more innovative in the long run. So, alongside the current project, you take the first steps for a new project that focusses on the new approach. Price: 1 Legwork 1 Commitment 2 Professional Expertise	

APPENDICES

Catalyst 2: Risk Aversion Challenge: A report from the US points out a potential and very decisive problem considering you preferred technological solution. The report reaches the press, and you are severely criticized because the project's ethical aspects appear dubious, since the evidence of its effects is not more substantial that it is. What do you do?	Riskiness Rank 1-Lowest 2-Medium 3-Highest
Solution A- Turn the tide of public opinion You cannot always expect 100% proof when creating new solutions. We engage in the public debate at several levels, and try to counter the criticism and point out the advantages that the new treatment offers. Price: 2 Professional Expertise 2 Network 1 Delay	
Solution B- The Safe Path The project concerns both the apps and the monitoring of patients through implanted chips. The latter is probably the more innovative but also the more problematic, which is why we scrap that part and focus our energies on user friendly and innovative apps. Price: 1 Commitment 1 Finances	
Solution C- Strengthen the Evidence We believe our solutions, but we cannot tolerate too much uncertainty. Therefore, we apply for grants to extend the test period. In this way, we can further substantiate the evidence and deflect criticism. Price: 1 Legwork 1 Professional Expertise 1 Mandate	

APPENDICES

<p>Catalyst 3: The Future Life of the Project</p> <p>Challenge: The project will expire soon, and there are no immediate funds or any will to extend it. Based on your success parameters and number of delays that you have accumulated, you can gain a preliminary impression of where you stand at the moment. The treatment is, at present, implemented to a higher or lesser degree in the municipality and/or the region. But the question is how you will maintain and develop the knowledge and know-how which the project has generated?</p>	<p>Riskiness Rank</p> <p>1-Lowest 2-Medium 3-Highest</p>
<p>Solution A- The Danish Health and Medicine Authority</p> <p>We submit the treatment to be elevated as a standard or recommendation from the Health and Medicine Authority. It is challenging, and we lose control of the project, but if successful, we will ensure the dissemination of the treatment.</p> <p>Price:</p> <ul style="list-style-type: none"> 1 Legwork 1 Professional Expertise 1 Mandate 	
<p>Solution B- The Power of Positive Example</p> <p>We make use of our own operations as a positive example and disseminate knowledge of our results through conferences, personal networks, and by inviting interested parties to visit us. This demands hard work, but also allows us to communicate our knowledge according to our own choosing.</p> <p>Price:</p> <ul style="list-style-type: none"> 1 Legwork 1 Commitment 1 Network 1 Finance 	
<p>Solution C- Rinse and Repeat</p> <p>We dispassionately designate the elements that did not work well in the project, and discard them. Following this, we focus on what actually paid off and use this as a launch pad for a new development project. No immediate results are achieved, but we hope for a pay-off in the long term.</p> <p>Price:</p> <ul style="list-style-type: none"> 1 Commitment 1 Mandate 	

APPENDICES

APPENDIX E: CHANGE NAVIGATOR GAMEPLAY TRACKING SHEET

Gameplay Tracking Sheet

Date _____ / _____ / _____ Group # _____ Circle one: Non-blended Blended

Phase 1: Initiate

Action Card 1: Vision Meeting

Action Card 2: _____ Change Fuel Chips: _____.

Action Card 3: _____ Change Fuel Chips: _____.

Action Card 4: _____ Change Fuel Chips: _____.

Time to Complete Phase: _____ min

Score: _____

Zone	Beginning	Action Card 1	Action Card 2	Action Card 3	Action Card 4
No +					
No -					
Yes -					
Yes +					

Phase 2: Accelerate

Action Card 1: _____ Change Fuel Chips: _____.

Action Card 2: _____ Change Fuel Chips: _____.

Action Card 3: _____ Change Fuel Chips: _____.

Action Card 4: _____ Change Fuel Chips: _____.

Time to Complete Phase: _____ min

APPENDICES

Score: _____

Zone	Beginning	Action Card 1	Action Card 2	Action Card 3	Action Card 4
No +					
No -					
Yes -					
Yes +					

Phase 3: Integrate

Action Card 1: _____ Change Fuel Chips: _____.

Action Card 2: _____ Change Fuel Chips: _____.

Action Card 3: _____ Change Fuel Chips: _____.

Action Card 4: _____ Change Fuel Chips: _____.

Time to Complete Phase: _____ min

Final Score: _____

Zone	Beginning	Action Card 1	Action Card 2	Action Card 3	Action Card 4
No +					
No -					
Yes -					
Yes +					

APPENDICES

APPENDIX F: CO-CREATOR QUESTIONNAIRE

Co-Creator Questionnaire

Circle one response for each of the following items.

When playing Co-Creator...	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
1. I lose track of time.	1	2	3	4	5
2. The game felt out of my control.	1	2	3	4	5
3. I feel different about innovation.*	1	2	3	4	5
4. I felt nervous/apprehensive about decisions made in the game.*	1	2	3	4	5
5. The game feels like a real scenario.*	1	2	3	4	5
6. I get frustrated by the results of the game.**	1	2	3	4	5
7. I feel disconnected to the other players.	1	2	3	4	5
8. I feel fatigued.*	1	2	3	4	5
9. Playing seems automatic.	1	2	3	4	5
10. My thoughts race.*	1	2	3	4	5
11. I play without thinking about how to play.	1	2	3	4	5
12. Playing makes me feel calm.	1	2	3	4	5
13. I play longer than I meant to.	1	2	3	4	5
14. I really get into the game.	1	2	3	4	5
15. I feel like I can't stop playing.	1	2	3	4	5
16. When the other players were happy, I was happy.	1	2	3	4	5

APPENDICES

17. When I was happy, the other players were happy.	1	2	3	4	5
18. I empathized with the other players.	1	2	3	4	5
19. I felt connected to the other players.	1	2	3	4	5
20. I admired the other players.	1	2	3	4	5
21. I found it enjoyable to be with the other(s).	1	2	3	4	5
22. I sympathized with the other players.	1	2	3	4	5
23. I tended to ignore the other players.	1	2	3	4	5
24. The other players tended to ignore me.	1	2	3	4	5
25. I felt like the others didn't take enough risks.**	1	2	3	4	5
26. I felt like I could have made better decisions alone.**	1	2	3	4	5
27. I felt like my opinion was not heard.**	1	2	3	4	5
28. I felt like someone else took control.**	1	2	3	4	5
29. I felt like the other players took too many risks.**	1	2	3	4	5
30. My actions depended on the other players' actions.	1	2	3	4	5
31. The other players' actions were dependent on my actions.	1	2	3	4	5
32. What the others did affected what I did.	1	2	3	4	5
33. What I did affected what the other players' did.	1	2	3	4	5
34. The others paid close attention to me.	1	2	3	4	5
35. I paid close attention to the other players.	1	2	3	4	5
36. My intentions were clear to the other players.	1	2	3	4	5

APPENDICES

37. The other players' intentions were clear to me.	1	2	3	4	5
38. Co-Creator presented a risk-free environment to make innovation decisions.**	1	2	3	4	5
39. I understand consequences of innovative decisions now.**	1	2	3	4	5
40. I will use strategies presented in Co-Creator in future decisions.**	1	2	3	4	5
41. The game was easy to navigate/the instructions were clear.**	1	2	3	4	5
42. I would recommend Co-Creator to my colleagues.**	1	2	3	4	5
*edited from original GEQ or SPGQ **new statement					

APPENDICES

APPENDIX G: CHANGE NAVIGATOR QUESTIONNAIRE

Change Navigator Questionnaire

Circle one response for each of the following items.

When playing Change Navigator...	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
1. I lose track of time.	1	2	3	4	5
2. The game felt out of my control.	1	2	3	4	5
3. I feel different about change in the workplace.*	1	2	3	4	5
4. I felt nervous/apprehensive about decisions made in the game.*	1	2	3	4	5
5. The game feels like a real business scenario.*	1	2	3	4	5
6. I get frustrated by the results of the game.**	1	2	3	4	5
7. I feel disconnected to the other players.	1	2	3	4	5
8. I feel fatigued.*	1	2	3	4	5
9. Playing seems automatic.	1	2	3	4	5
10. My thoughts race.*	1	2	3	4	5
11. I play without thinking about how to play.	1	2	3	4	5
12. Playing makes me feel calm.	1	2	3	4	5
13. I play longer than I meant to.	1	2	3	4	5
14. I really get into the game.	1	2	3	4	5
15. I feel like I can't stop playing.	1	2	3	4	5
16. When the other players were happy, I was happy.	1	2	3	4	5

APPENDICES

17. When I was happy, the other players were happy.	1	2	3	4	5
18. I empathized with the other players.	1	2	3	4	5
19. I felt connected to the other players.	1	2	3	4	5
20. I admired the other players.	1	2	3	4	5
21. I found it enjoyable to be with the other(s).	1	2	3	4	5
22. I sympathized with the other players.	1	2	3	4	5
23. I tended to ignore the other players.	1	2	3	4	5
24. The other players tended to ignore me.	1	2	3	4	5
25. I felt like the others didn't take enough risks.**	1	2	3	4	5
26. I felt like I could have made better decisions alone.**	1	2	3	4	5
27. I felt like my opinion was not heard.**	1	2	3	4	5
28. I felt like someone else took control.**	1	2	3	4	5
29. I felt like the other players took too many risks.**	1	2	3	4	5
30. My actions depended on the other players' actions.	1	2	3	4	5
31. The other players' actions were dependent on my actions.	1	2	3	4	5
32. What the others did affected what I did.	1	2	3	4	5
33. What I did affected what the other players did.	1	2	3	4	5
34. The others paid close attention to me.	1	2	3	4	5
35. I paid close attention to the other players.	1	2	3	4	5
36. My intentions were clear to the other players.	1	2	3	4	5

APPENDICES

37. The other players' intentions were clear to me.	1	2	3	4	5
38. Change Navigator presented a risk-free environment to make business decisions.**	1	2	3	4	5
39. I understand consequences of change in the workplace now.**	1	2	3	4	5
40. I will use strategies presented in Change Navigator in future decisions.**	1	2	3	4	5
41. The game was easy to navigate/the instructions were clear.**	1	2	3	4	5
42. I enjoyed having the facilitator present.**	1	2	3	4	5
43. I would recommend Change Navigator to my colleagues.**	1	2	3	4	5
44. I felt like the presence of the facilitator impacted my decision-making process.**	1	2	3	4	5
*edited from original GEQ or SPGQ **new statement					

APPENDICES

APPENDIX H: CO-CREATOR INTERVIEW QUESTIONS

Co-Creator Interview Questions

1. Did you enjoy playing Co-Creator?
2. Which parts or aspects of the game made it enjoyable?
3. Which parts or aspects of the game did you not find enjoyable?
4. What improvements do you think could be made to Co-Creator?
5. What aspects of the game did you find realistic or unrealistic?
6. How was playing the game as a group?
 - a. Did you agree or disagree with the decisions made?
 - b. How comfortable were you with the other players?
7. Was the camera distracting?
8. Did knowing that you were being filmed impact the decisions you made? If so, how?
9. For blended: Did knowing that your moves were being tracked impact the decisions you made? If so, how?
Do you think that it influenced whether or not you chose riskier cards?
10. On a scale of 1 to 5, how easy was it to identify which solution would give you positive or negative results (1=easy, 5=difficult to discern). Can you explain your ranking?

Interactive Task: Pile sort each Challenge Card's Solutions (A, B, C) according to riskiness (1-lowest, 2-medium, 3-highest)

APPENDICES

APPENDIX I: CODED INTERVIEW SHEET

Co-Creator Coded Interview Sheet					
Group Number		1	2	3	4
Blended/Non-blended					
Did you enjoy playing Co-Creator?	Generally Yes				
	Generally No				
Which parts or aspects of the game made it enjoyable?					
What improvements do you think could be made to Co-Creator?					
How was playing the game as a group?	Generally Good	<p>Fill in Paraphrased Interview Notes Here</p>			
	Generally Bad				
Did you agree or disagree with the decisions made?	Generally Yes				
	Generally No				
How comfortable were you with the other players?					
What aspects of the game did you find realistic or unrealistic?	Generally Realistic				
	Generally Unrealistic				
Was the camera distracting?	Generally Yes				
	Generally No				
Did knowing that you were being filmed impact the decisions you made? If so, how?	Generally Yes Explain How				
	Generally No				
On a scale of 1 to 5, how easy was it to identify which action cards would give you positive results?	Rank				
	Explain Your Ranking				

APPENDICES

APPENDIX J: CHANGE NAVIGATOR INTERVIEW QUESTIONS

Change Navigator Interview Questions

1. Did you enjoy playing Change Navigator?
2. Which parts or aspects of the game made it enjoyable?
3. Which parts or aspects of the game did you not find enjoyable?
4. What improvements do you think could be made to Change Navigator?
5. What aspects of the game did you find realistic or unrealistic?
6. How was playing the game as a group?
7. Did you agree or disagree with the decisions made?
8. How comfortable were you with the other players?
9. How did the facilitator help you in the game?
10. Did the presence of the facilitator impact the decisions you made? If so, how?
11. Was the camera distracting?
12. Did knowing that you were being filmed impact the decisions you made? If so, how?
13. For blended: Did knowing that your moves were being tracked impact the decisions you made? If so, how?
14. Do you think that it influenced whether or not you chose riskier cards?
15. On a scale of 1 to 5, how easy was it to identify which action cards would give you positive or negative results (1=easy, 5=difficult to discern). Can you explain your ranking?

Interactive Task: Pile sort action cards according to riskiness using the categories: very low, low, medium, high, very high

APPENDICES

APPENDIX K: JAVA CODE FOR GENERATION OF RANDOM CO-CREATOR DATA

```
import java.io.BufferedWriter;
import java.io.File;
import java.io.FileWriter;
import java.io.IOException;
import java.util.ArrayList;

public class Start {
    static public ArrayList<Integer> choiceList = new ArrayList<Integer>();
    static ArrayList<String> sponsorList = new ArrayList<String>();
    static ArrayList<String> resList = new ArrayList<String>();
    static int[] score = { 0, 0, 0 };
    // resources
    static int finance = 0;
    static int proexpert = 0;
    static int legwork = 0;
    static int mandate = 0;
    static int network = 0;
    static int commitment = 0;
    static int delay = 0;
    static int delayExchange = 0;
    static int amount = 0;

    public Start(ArrayList<Integer> choiceList, ArrayList<String> sponsorList, int[]
score, int finance, int proexpert,
                int legwork, int mandate, int network, int commitment, int delay,
int delayExchange, int amount) {
        super();
        Start.choiceList = choiceList;
        Start.sponsorList = sponsorList;
        Start.score = score;
        Start.finance = finance;
        Start.proexpert = proexpert;
        Start.legwork = legwork;
        Start.mandate = mandate;
        Start.network = network;
```

APPENDICES

```
        Start.commitment = commitment;
        Start.delay = delay;
        Start.delayExchange = delayExchange;
        Start.amount = amount;
    }

    public static void main(String[] args) throws IOException {
        File file = new File("theIQPRandomData.txt");
        BufferedWriter outputTxt = new BufferedWriter(new FileWriter(file));
        int testCounted = 0;
        double[] finalList = { 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 };
        int i = 0;
        while (i < 24) {
            resources();
            if (delay <= 5) {
                int finalScore = (score[0] + score[1] + score[2]) / 3; // rounds

                // down
                if (delay >= 6) {
                    finalScore = finalScore - 1;
                } else if (delay <= 3) {
                    finalScore = finalScore + 1;
                }
                if (finalScore >= 2) {
                    i++;
                    testCounted++;
                    for (int j = 0; j < choiceList.size(); j++) {
                        finalList[j] = finalList[j] + choiceList.get(j);
                    }
                    outputTxt.write(resList + "");
                    outputTxt.newLine();
                    String allChoice = choiceList + "--> " + delay;
                    outputTxt.write(allChoice);
                    outputTxt.newLine();
                    outputTxt.write("Culture:" + score[0]);
                    outputTxt.newLine();
                }
            }
            i++;
        }
    }
}
```

APPENDICES

```
        outputTxt.write("Solution:" + score[1]);
        outputTxt.newLine();
        outputTxt.write("Goal:" + score[2]);
        outputTxt.newLine();
        outputTxt.write("Final Score:" + finalScore);
        outputTxt.newLine();
        // resList.add("Delays exchanged:" + delayExchange);
        outputTxt.write(".....");
        outputTxt.newLine();
    }
}
choiceList = new ArrayList<Integer>();
sponsorList = new ArrayList<String>();
resList = new ArrayList<String>();
score[0] = 0;
score[1] = 0;
score[2] = 0;
finance = 0;
proexpert = 0;
legwork = 0;
mandate = 0;
network = 0;
commitment = 0;
delay = 0;
delayExchange = 0;
amount = 0;
}
// for(int i = 0; i < finalList.length;i++)
// {
// finalList[i] = finalList[i]/testCounted;
// resList.add("Average choices for " + i + " :" + finalList[i] );
// }
outputTxt.write("Total tests:" + testCounted);
outputTxt.newLine();
```

APPENDICES

```
        outputTxt.close();
    }

    public static int[] choices(String str) {
        return score;
    }

    public static void takeOne(int resourceNum) {
        if (resourceNum == 0) {
            if (finance >= 1) {
                finance = finance - 1;
            } else {
                delay = delay + 1;
                delayExchange++;
            }
        }
        if (resourceNum == 1) {
            if (proexpert >= 1) {
                proexpert = proexpert - 1;
            } else {
                delay = delay + 1;
                delayExchange++;
            }
        }
        if (resourceNum == 2) {
            if (legwork >= 1) {
                legwork = legwork - 1;
            } else {
                delay = delay + 1;
                delayExchange++;
            }
        }
        if (resourceNum == 3) {
```


APPENDICES

```
        if (mandate >= 1) {
            mandate = mandate - 1;
        } else {
            delay = delay + 1;
            delayExchange++;
        }
    }
    if (resourceNum == 4) {
        if (network >= 1) {
            network = network - 1;
        } else {
            delay = delay + 1;
            delayExchange++;
        }
    }
    if (resourceNum == 5) {
        if (commitment >= 1) {
            commitment = commitment - 1;
        } else {
            delay = delay + 1;
            delayExchange++;
        }
    }
}
```

```
public static void takeTwo(int resourceNum) {
    if (resourceNum == 0) {
        if (finance >= 2) {
            finance = finance - 2;
        } else if (finance == 1) {
            finance = finance - 1;
            delay = delay + 1;
            delayExchange++;
        } else {
            delay = delay + 2;
        }
    }
}
```

APPENDICES

```
        delayExchange = delayExchange + 2;
    }
}
if (resourceNum == 1) {
    if (proexpert >= 2) {
        proexpert = proexpert - 2;
    } else if (proexpert == 1) {
        proexpert = proexpert - 1;
        delay = delay + 1;
        delayExchange++;
    } else {
        delay = delay + 2;
        delayExchange = delayExchange + 2;
    }
}
if (resourceNum == 2) {
    if (legwork >= 2) {
        legwork = legwork - 2;
    } else if (legwork == 1) {
        legwork = legwork - 1;
        delay = delay + 1;
        delayExchange++;
    } else {
        delay = delay + 2;
        delayExchange = delayExchange + 2;
    }
}
if (resourceNum == 3) {
    if (mandate >= 2) {
        mandate = mandate - 2;
    } else if (mandate == 1) {
        mandate = mandate - 1;
        delay = delay + 1;
        delayExchange++;
    } else {
```

APPENDICES

```
        delay = delay + 2;
        delayExchange = delayExchange + 2;
    }
}
if (resourceNum == 4) {
    if (network >= 2) {
        network = network - 2;
    } else if (network == 1) {
        network = network - 1;
        delay = delay + 1;
        delayExchange++;
    } else {
        delay = delay + 2;
        delayExchange = delayExchange + 2;
    }
}
if (resourceNum == 5) {
    if (commitment >= 2) {
        commitment = commitment - 2;
    } else if (commitment == 1) {
        commitment = commitment - 1;
        delay = delay + 1;
        delayExchange++;
    } else {
        delay = delay + 2;
        delayExchange = delayExchange + 2;
    }
}
}

public static void resCollection() {
    for (int i = 0; i < sponsorList.size() - 1; i++) {
        if (sponsorList.get(i).equals("Danish Council of Ethics")) {
            proexpert = proexpert + 1;
            mandate = mandate + 1;
        }
    }
}
```

APPENDICES

```
    }
    if (sponsorList.get(i).equals("Scandipharma")) {
        legwork = legwork + 1;
        finance = finance + 1;
    }
    if (sponsorList.get(i).equals("CBS")) // this sponsor has some weird

// random thing
    {
        int rand1 = (int) ((Math.random() * 4) + 1);
        if (rand1 == 1) {
            mandate = mandate + 1;
            int rand2 = (int) ((Math.random() * 3) + 1);
            if (rand2 == 1) {
                proexpert = proexpert + 1;
            }
            if (rand2 == 2) {
                network = network + 1;
            }
            if (rand2 == 3) {
                legwork = legwork + 1;
            }
        } else if (rand1 == 2) {
            proexpert = proexpert + 1;
            int rand2 = (int) ((Math.random() * 3) + 1);
            if (rand2 == 1) {
                mandate = mandate + 1;
            } else if (rand2 == 2) {
                network = network + 1;
            } else if (rand2 == 3) {
                legwork = legwork + 1;
            }
        } else if (rand1 == 3) {
            network = network + 1;
            int rand2 = (int) ((Math.random() * 3) + 1);
            if (rand2 == 1) {
```

APPENDICES

```
        mandate = mandate + 1;
    } else if (rand2 == 2) {
        proexpert = proexpert + 1;
    } else if (rand2 == 3) {
        legwork = legwork + 1;
    }
} else if (rand1 == 4) {
    legwork = legwork + 1;
    int rand2 = (int) ((Math.random() * 3) + 1);
    if (rand2 == 1) {
        mandate = mandate + 1;
    } else if (rand2 == 2) {
        network = network + 1;
    } else if (rand2 == 3) {
        proexpert = proexpert + 1;
    }
}
}
if (sponsorList.get(i).equals("Aarhus University Hospital")) {
    proexpert = proexpert + 1;
    int rand = (int) ((Math.random() * 2) + 1);
    if (rand == 1) {
        legwork = legwork + 1;
    } else if (rand == 2) {
        network = network + 1;
    }
}
if (sponsorList.get(i).equals("App-Medic")) {
    finance = finance + 1;
    commitment = commitment + 1;
}
if (sponsorList.get(i).equals("The Danish heart Asociation")) {
    network = network + 1;
    int rand = (int) ((Math.random() * 2) + 1);
    if (rand == 1) {
```

APPENDICES

```
        proexpert = proexpert + 1;
    } else if (rand == 2) {
        commitment = commitment + 1;
    }
}
if (sponsorList.get(i).equals("Patient Network")) {
    commitment = commitment + 1;
    int rand = (int) ((Math.random() * 2) + 1);
    if (rand == 1) {
        network = network + 1;
    } else if (rand == 2) {
        mandate = mandate + 1;
    }
}
if (sponsorList.get(i).equals("Local Politician")) {
    mandate = mandate + 1;
    int rand = (int) ((Math.random() * 2) + 1);
    if (rand == 1) {
        legwork = legwork + 1;
    } else if (rand == 2) {
        finance = finance + 1;
    }
}
if (sponsorList.get(i).equals("Patient Ambassadors")) {
    network = network + 1;
    int rand = (int) ((Math.random() * 2) + 1);
    if (rand == 1) {
        legwork = legwork + 1;
    } else if (rand == 2) {
        commitment = commitment + 1;
    }
}
}
}
```

APPENDICES

```
public static void resStart() {
    while (amount < 4) {
        int sponsor = (int) ((Math.random() * 9) + 1); // random number

        // between 1-9 to

        // decide which

        // sponsor to pick
        if (sponsor == 1) {
            proexpert = proexpert + 2;
            mandate = mandate + 2;
            sponsorList.add("Danish Council of Ethics");
            amount++;
        }
        if (sponsor == 2) {
            proexpert = proexpert + 1;
            legwork = legwork + 2;
            finance = finance + 2;
            sponsorList.add("Scandipharma");
            amount++;
        }
        if (sponsor == 3) {
            proexpert = proexpert + 1;
            mandate = mandate + 1;
            legwork = legwork + 1;
            network = network + 1;
            sponsorList.add("CBS");
            amount++;
        }
        if (sponsor == 4) {
            proexpert = proexpert + 2;
            commitment = commitment + 1;
            network = network + 1;
            sponsorList.add("Aarhus University Hospital");
            amount++;
        }
    }
}
```

APPENDICES

```
}
if (sponsor == 5) {
    finance = finance + 2;
    commitment = commitment + 1;
    legwork = legwork + 1;
    network = network + 1;
    sponsorList.add("App-Medic");
    amount++;
}
if (sponsor == 6) {
    proexpert = proexpert + 1;
    commitment = commitment + 1;
    network = network + 2;
    sponsorList.add("The Danish heart Asociation");
    amount++;
}
if (sponsor == 7) {
    mandate = mandate + 1;
    commitment = commitment + 2;
    network = network + 1;
    sponsorList.add("Patient Network");
    amount++;
}
if (sponsor == 8) {
    legwork = legwork + 1;
    finance = finance + 2;
    mandate = mandate + 2;
    sponsorList.add("Local Politician");
    amount++;
}
if (sponsor == 9) {
    legwork = legwork + 1;
    commitment = commitment + 1;
    network = network + 2;
    sponsorList.add("Patient Ambassadors");
```


APPENDICES

```
        amount++;
    }
}

public static void resources() {
    resStart();
    resList.add("S:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
        + commitment + ", " + delay + "}");
    // outputTxt.newLine();
    int count = 0;
    while (true) {
        int option1 = (int) ((Math.random() * 3) + 1); // random number

        // between 1-3 to

        // pick an option
        if (option1 == 1) {
            if (proexpert >= 1 && mandate >= 1 && commitment >= 1 ||
count >= 10) {

                choiceList.add(1);
                takeOne(2);
                takeOne(5);
                takeOne(1);
                score[0] = score[0] + 1;
                break;
            }
        }
        if (option1 == 2) {
            if (mandate >= 2 || count >= 10) {
                choiceList.add(2);
                takeTwo(3);
                score[2] = score[2] + 1;
                finance = finance + 1;
                delay = delay + 1;
            }
        }
    }
}
```

APPENDICES

```
                break;
            }
        }
        if (option1 == 3) {
            if (network >= 1 && commitment >= 1 || count >= 10) {
                choiceList.add(3);
                takeOne(5);
                takeOne(4);
                score[0] = score[0] + 1;
                score[1] = score[1] + 1;
                break;
            }
        }
        count++;
    }
    resList.add("1:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
                + commitment + ", " + delay + "}");
    // outputTxt.newLine();

count = 0;
while (true) {
    int option2 = (int) ((Math.random() * 3) + 1); // random number

    // between 1-3 to

    // pick an option
    if (option2 == 1) {
        if (proexpert >= 2 || count >= 10) {
            choiceList.add(1);
            takeTwo(1);
            delay = delay + 1;
            break;
        }
    }
    if (option2 == 2) {
```

APPENDICES

```

        if (proexpert >= 2 && legwork >= 1 || count >= 10) {
            choiceList.add(2);
            takeOne(2);
            takeTwo(1);
            score[1] = score[1] + 1;
            if (legwork >= 1) // assume that you would do this if
                // could. also
                // to be random
            {
                takeOne(2);
                score[0] = score[0] + 1;
            } else if (commitment >= 1) {
                takeOne(5);
                score[0] = score[0] + 1;
            }
            break;
        }
    }
    if (option2 == 3) {
        if (finance >= 2 && commitment >= 1 || count >= 10) {
            choiceList.add(3);
            takeOne(5);
            takeTwo(0);
            score[0] = score[0] + 1;
            score[1] = score[1] + 1;
            if (commitment >= 1) {
                int rand = (int) ((Math.random() * 2) + 1); //
                // chance of
                // taking
            }
        }
    }
}

```

you

always legwork first. fix

later

random

APPENDICES

```
        // the delay

        // for goal
        if (rand == 2) {
            takeOne(5);
            delay = delay + 1;
            score[2] = score[2] + 1;
        }
    }
    break;
}
}
count++;
}
resList.add("2:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
        + commitment + ", " + delay + "}");
// outputTxt.newLine();
count = 0;
while (true) {
    int option3 = (int) ((Math.random() * 3) + 1); // random number

    // between 1-3 to

    // pick an option
    if (option3 == 1) {
        if (network >= 1 && proexpert >= 1 && commitment >= 1 ||
count >= 10) {
            choiceList.add(1);
            takeOne(5);
            takeOne(1);
            takeOne(4);
            score[0] = score[0] + 1;
            if (commitment >= 1) {
                takeOne(5);
            }
        }
    }
}
```

APPENDICES

```
        }
        break;
    }
}
if (option3 == 2) {
    if (legwork >= 2 && network >= 2 || count >= 10) {
        choiceList.add(2);
        takeTwo(2);
        takeTwo(4);
        score[0] = score[0] + 1;
        score[1] = score[1] + 2;
        break;
    }
}
if (option3 == 3) {
    if (commitment >= 2 || count >= 10) {
        choiceList.add(3);
        takeTwo(5);
        score[0] = score[0] + 1;
        break;
    }
}
count++;
}
resList.add("3:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
        + commitment + ", " + delay + "}");
// outputTxt.newLine();
resCollection();
resList.add("B:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
        + commitment + ", " + delay + "}");
// outputTxt.newLine();
count = 0;
while (true) {
    int option4 = (int) ((Math.random() * 3) + 1); // random number
```

APPENDICES

```
// between 1-3 to

// pick an option
if (option4 == 1) {
    if (proexpert >= 1 && finance >= 1 || count >= 10) {
        choiceList.add(1);
        takeOne(1);
        takeOne(0);
        score[0] = score[0] + 2;
        break;
    }
}
if (option4 == 2) {
    if (legwork >= 1 && network >= 1 && finance >= 2 || count >=
10) {

        choiceList.add(2);
        takeTwo(0);
        takeOne(4);
        takeOne(2);
        score[0] = score[0] + 2;
        if (score[1] < 4) {
            score[1] = 4;
        }
        break;
    }
}
if (option4 == 3) {
    if (mandate >= 2 || count >= 10) {
        choiceList.add(3);
        takeTwo(3);
        score[0] = score[0] + 1;
        score[1] = score[1] + 1;
        int rand = (int) ((Math.random() * 4));
        sponsorList.remove(rand);
    }
}
```

APPENDICES

```

random and
    rand = (int) ((Math.random() * 5)); // completely

    // could take delay
    takeOne(rand);
    takeOne(rand);
    if (delay > 0) {
        delay = delay - 1;
        if (delayExchange > 0) {
            delayExchange--;
        }
    }
    break;
}
}
count++;
}
resList.add("4:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
+ commitment + ", " + delay + "}");
// outputTxt.newLine();
count = 0;
while (true) {
    int option5 = (int) ((Math.random() * 3) + 1); // random number

    // between 1-3 to

    // pick an option
    if (option5 == 1) {
        if (legwork >= 1 && proexpert >= 1 && finance >= 1 || count
>= 10) {
            choiceList.add(1);
            takeOne(2);
            takeOne(1);
            takeOne(0);
            score[1] = score[1] + 1;

```

APPENDICES

```
        score[2] = score[2] + 1;
        if (score[0] >= 1) {
            score[0] = score[0] - 1;
        }
        break;
    }
}
if (option5 == 2) {
    if (network >= 1 && mandate >= 1 || count >= 10) {
        choiceList.add(2);
        takeOne(3);
        takeOne(4);
        if (score[0] >= 4 || score[1] >= 4) {
            score[2] = score[2] + 1;
        } else {
            delay = delay + 1;
        }
        break;
    }
}
if (option5 == 3) {
    if (mandate >= 2 && proexpert >= 1 || count >= 10) {
        choiceList.add(3);
        takeOne(1);
        takeTwo(3);
        if (delay >= 1) {
            delay = delay - 1;
            if (delayExchange > 0) {
                delayExchange--;
            }
        }
        score[0] = score[0] + 1;
        score[2] = score[2] + 2;
        break;
    }
}
```


APPENDICES

```
        }
        count++;
    }
    resList.add("5:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
                + commitment + ", " + delay + "}");
    // outputTxt.newLine();
    count = 0;
    while (true) {
        int option6 = (int) ((Math.random() * 3) + 1); // random number

        // between 1-3 to

        // pick an option
        if (option6 == 1) {
            if (legwork >= 2 && proexpert >= 1 && commitment >= 1 ||
count >= 10) {

                choiceList.add(1);
                takeTwo(2);
                takeOne(5);
                takeOne(1);
                score[0] = score[0] + 1;
                if (score[1] >= 1) {
                    score[1] = score[1] - 1;
                }
                score[2] = score[2] + 1;
                if (commitment >= 1) {
                    takeOne(5);
                    score[2] = score[2] + 1;
                }
                break;
            }
        }
        if (option6 == 2) {
            if (legwork >= 2 || count >= 10) {
                choiceList.add(2);
            }
        }
    }
}
```

APPENDICES

```
        takeTwo(2);
        delay = delay + 1;
        finance = finance + 1;
        if (score[0] >= 1) {
            score[0] = score[0] - 1;
        }
        break;
    }
}
if (option6 == 3) {
    if (mandate >= 1 && proexpert >= 1 && commitment >= 1 ||
count >= 10) {
        choiceList.add(3);
        takeOne(5);
        takeOne(1);
        takeOne(3);
        score[0] = score[0] + 1;
        score[2] = score[2] + 1;
        break;
    }
}
count++;
}
resList.add("6:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
        + commitment + ", " + delay + "}");
// outputTxt.newLine();
resCollection();
resList.add("B:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
        + commitment + ", " + delay + "}");
// outputTxt.newLine();
count = 0;
while (true) {
    int option7 = (int) ((Math.random() * 3) + 1); // random number
```

APPENDICES

```
// between 1-3 to

// pick an option
if (option7 == 1) {
    if (finance >= 2 && commitment >= 1 || count >= 10) {
        choiceList.add(1);
        takeOne(5);
        takeTwo(0);
        score[2] = score[2] + 1;
        break;
    }
}
if (option7 == 2) {
    if (mandate >= 1 && network >= 1 && legwork >= 2 || count
>= 10) {

        choiceList.add(2);
        takeOne(3);
        takeOne(4);
        takeTwo(2);
        score[1] = score[1] + 1;
        score[2] = score[2] + 2;
        delay = delay + 1;
        break;
    }
}
if (option7 == 3) {
    if (legwork >= 1 && proexpert >= 2 && commitment >= 1 ||
count >= 10) {

        choiceList.add(3);
        takeOne(2);
        takeOne(5);
        takeTwo(1);
        break;
    }
}
}
```

APPENDICES

```
        count++;
    }
    resList.add("7:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
        + commitment + ", " + delay + "}");
    // outputTxt.newLine();
    count = 0;
    while (true) {
        int option8 = (int) ((Math.random() * 3) + 1); // random number

        // between 1-3 to

        // pick an option
        if (option8 == 1) {
            if (network >= 2 && proexpert >= 2 || count >= 10) {
                choiceList.add(1);
                takeTwo(1);
                takeTwo(4);
                delay = delay + 1;
                score[0] = score[0] + 1;
                score[2] = score[2] + 2;
                int check = 0;
                for (int i = 0; i < sponsorList.size() - 1; i++) {
                    if (sponsorList.get(i).equals("Danish Council of
Ethics")) {
                        check = 1;
                    }
                    if (score[1] < 6 && check == 0) {
                        delay = delay + 1;
                    }
                }
                break;
            }
        }
        if (option8 == 2) {
```

APPENDICES

```
        if (finance >= 1 && commitment >= 1 || count >= 10) {
            choiceList.add(2);
            takeOne(5);
            takeOne(0);
            if (score[0] >= 1) {
                score[0] = score[0] - 1;
            }
            if (score[1] >= 1) {
                score[1] = score[1] - 1;
            }
            score[2] = score[2] + 1;
            break;
        }
    }
    if (option8 == 3) {
        if (mandate >= 1 && proexpert >= 1 && legwork >= 1 || count
        >= 10) {
            choiceList.add(3);
            takeOne(2);
            takeOne(1);
            takeOne(3);
            delay = delay + 1;
            if (score[0] >= 1) {
                score[0] = score[0] - 1;
            }
            score[1] = score[1] + 1;
            delay = delay + 1;
            if (delay < 5) {
                score[2] = score[2] + 1;
            }
            break;
        }
    }
    count++;
}
```

APPENDICES

```
resList.add("8:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
        + commitment + ", " + delay + "}");
// outputTxt.newLine();
count = 0;
while (true) {
    int option9 = (int) ((Math.random() * 3) + 1); // random number

    // between 1-3 to

    // pick an option
    if (option9 == 1) {
        if (mandate >= 1 && proexpert >= 1 && commitment >= 1 ||
count >= 10) {
            choiceList.add(1);
            takeOne(2);
            takeOne(3);
            takeOne(1);
            if (score[0] >= 1) {
                score[0] = score[0] - 1;
            }
            score[2] = score[2] + 1;
            for (int i = 0; i < sponsorList.size() - 1; i++) {
                if (sponsorList.get(i).equals("Patient
Network")
                                ||
sponsorList.get(i).equals("Patient Ambassadors")
                                ||
sponsorList.get(i).equals("Aarhus University Hospital")) {
                    score[2] = score[2] + 1;
                }
            }
            break;
        }
    }
    if (option9 == 2) {
```

APPENDICES

```
        if (network >= 1 && legwork >= 1 && commitment >= 1 &&
finance >= 1 || count >= 10) {
            choiceList.add(2);
            takeOne(2);
            takeOne(5);
            takeOne(4);
            takeOne(0);
            score[0] = score[0] + 2;
            score[2] = score[2] + 1;
            break;
        }
    }
    if (option9 == 3) {
        if (mandate >= 1 && proexpert >= 1 && commitment >= 1 ||
count >= 10) {
            choiceList.add(3);
            takeOne(5);
            takeOne(3);
            if (score[1] >= 7) {
                score[2] = score[2] + 1;
            }
            score[0] = score[0] + 1;
            score[1] = score[1] + 1;
            break;
        }
    }
    count++;
}
resList.add("9:{" + finance + ", " + proexpert + ", " + legwork + ", " + mandate
+ ", " + network + ", "
        + commitment + ", " + delay + "}");
// outputTxt.newLine();
}
}
```

APPENDICES

APPENDIX L: PILOT TEST RESOURCE FRACTION

Date	3/23/2016	Researcher	Ashley	Version	Non-Blended, Round 1						
Phase 2: Initiator	Resource	Challenge 1			Challenge 2			Challenge 3			Average Resource Fraction
		Price	Resources Available	Fraction	Price	Resources Available	Fraction	Price	Resources Available	Fraction	
	Finances	0	2	0	0	2	0	0	2	0	0.42
	Professional Expertise	0	4	0	2	4	0.50	1	2	0.50	
	Legwork	0	2	0	1	2	0.50	0	1	0	
	Mandate	0	2	0	0	2	0	0	2	0	
	Network	1	4	0.25	0	3	0	1	3	0.33	
	Commitment	1	3	0.33	0	2	0	1	2	0.50	
	Delay	0	0		0	0		0	0		
	Delay as Resource	0	0		0	0		0	0		
Phase 4: Facilitator	Resource	Challenge 1			Challenge 2			Challenge 3			Average Resource Fraction
		Price	Resources Available	Fraction	Price	Resources Available	Fraction	Price	Resources Available	Fraction	
	Finances	2	3	0.67	0	1	0	0	1	0	0.46
	Professional Expertise	0	3	0	0	3	0	1	3	0.33	
	Legwork	1	2	0.50	0	1	0	0	1	0	
	Mandate	0	3	0	1	3	0.33	1	2	0.50	
	Network	1	3	0.33	1	2	0.50	0	1	0	
	Commitment	0	2	0	0	2	0	1	2	0.50	
	Delay	0	0		0	0		0	0		
Delay as Resource	0	0		0	0		0	0			
Phase 6: Catalyst	Resource	Challenge 1			Challenge 2			Challenge 3			Average Resource Fraction
		Price	Resources Available	Fraction	Price	Resources Available	Fraction	Price	Resources Available	Fraction	
	Finances	0	2	0	0	2	0	1	2	0.50	0.58

APPENDICES

Professional Expertise	2	4	0.50	1	2	0.50	0	1	0	
Legwork	1	3	0.33	1	2	0.50	1	1	1.00	
Mandate	0	2	0	1	2	0.50	0	1	0	
Network	0	2	0	0	2	0	1	2	0.50	
Commitment	1	2	0.50	0	1	0	1	1	1.00	
Delay	0	0		1	0		0	2		
Delay as Resource	0	0		0	0		0	0	Total Delays	
Overall Resource Fraction										0.49

Date	4/21/2016	Researcher	Sebastien	Version	Non-Blended, Round 2						
Phase 2: Initiator	Resource	Challenge 1			Challenge 2			Challenge 3			Average Resource Fraction
		Price	Resources Available	Fraction	Price	Resources Available	Fraction	Price	Resources Available	Fraction	
	Finances	0	6	0	0	6	0	0	6	0	
	Professional Expertise	1	3	0.33	0	2	0	2	2	1.00	
	Legwork	0	4	0	1	4	0.25	2	3	0.67	
	Mandate	0	2	0	2	2	1.00	0	0	0	
	Network	0	2	0	0	2	0	0	2	0	
	Commitment	1	2	0.50	0	1	0	0	1	0	0.63
	Delay	0	0		0	1(random)		0	0		
	Delay as Resource	0	0		0	0		0	0		
Phase 4: Facilitator	Resource	Challenge 1			Challenge 2			Challenge 3			Average Resource Fraction
		Price	Resources Available	Fraction	Price	Resources Available	Fraction	Price	Resources Available	Fraction	
	Finances	1	6	0.17	0	5	0	0	5	0	
	Professional Expertise	0	1	0	1	1	1.00	0	0	0	
	Legwork	0	3	0	0	3	0	2	3	0.67	
	Mandate	1	1	1.00	0	0	0	0	0	0	
	Network	0	3	0	1	3	0.33	0	2	0	
Commitment	0	2	0	0	2	0	0	2	0	0.69	

APPENDICES

	Delay	0	1		0	1		1	1		
	Delay as Resource	0	0		0	0		0	0		
Phase 6: Catalyst	Resource	Challenge 1			Challenge 2			Challenge 3			Average Resource Fraction
		Price	Resources Available	Fraction	Price	Resources Available	Fraction	Price	Resources Available	Fraction	
	Finances	2(took 1)	6	0.17	0	5	0	0	5	0	
	Professional Expertise	0	0	0	1	1	1.00	0	0	0	
	Legwork	0	4	0	0	3	0	0	3	0	
	Mandate	0	1	1.00	0	0	0	0	0	0	
	Network	0	3	0	1	3	0.33	1	2	0.50	
	Commitment	1	3	0	0	2	0	1	2	0.50	0.47
	Delay	0	2		0	2		0	3 (should be 4)		
	Delay as Resource	0	0		0	0		0		Total Delays	3 (should be 4)
Overall Resource Fraction											0.60

APPENDIX M: CO-CREATOR PILOT TEST SOLUTIONS AND SCORES

Co-Creator Pilot Test Solutions and Scores Round 1 (WPI Students)					
	Game Version	Blended	Blended	Non-Blended	Non-Blended
Phase 1: Initiator	Challenge 1: Common Starting Point	C-Common Narrative	C-Common Narrative	C-Common Narrative	B-Clear Mandate
	1: Innovative Culture Score:		1	1	1 0
	1: Innovative Solutions Score:		1	1	1 0
	1: Goal Attainment Score:		0	0	0 1
	Challenge 2: Workflows	C-External Project Office	C-External Project Office	B-Mobile Secretariat	A-Staying with Operations
	2: Innovative Culture Score:		2	2	1 0
	2: Innovative Solutions Score:		2	2	2 0
	2: Goal Attainment Score:		0	0	0 1
	Challenge 3: Kick off Event	A-Seminar	A-Seminar	A-Seminar	C-Workshop

APPENDICES

	3: Innovative Culture Score:	3	3	2	1
	3: Innovative Solutions Score:	2	2	2	0
	3: Goal Attainment Score	0	0	0	1
	Phase 2: Time to Complete	14:18	9:18	10:30	24:17
Phase 2: Facilitator	Challenge 1: Different Agendas	B-Field Trip	A-External Consultant	B-Field Trip	B-Field Trip
	1: Innovative Culture Score:	5	5	4	3
	1: Innovative Solutions Score:	4	2	4	4
	1: Goal Attainment Score:	0	0	0	1
	Challenge 2: Decision-Making Powers	A-Customize the New Technology	C-Breaking the Law	B-Dispensation	A-Customize the New Technology
	2: Innovative Culture Score:	4	6	4	2
	2: Innovative Solutions Score:	5	2	4	5
	2: Goal Attainment Score:	1	2	1	2
	Challenge 3: Local Opposition	B-Focus on Operations	B-Focus on Operations	C-The Hard-Line Approach	A-Involve the Departments
	3: Innovative Culture Score:	3	5	5	3
	3: Innovative Solutions Score:	5	2	4	4
	3: Goal Attainment Score:	1	2	2	4
	Phase 4: Time to Complete	14:30	8:14	14:45	15:40
	Phase 3	Challenge 1: Eye Opener	B-Reboot	B-Reboot	C-New Project
1: Innovative Culture Score:		3	5	6	3
1: Innovative Solutions Score:		6	3	5	5
1: Goal Attainment Score:		3	4	2	6
Phase 3: Catalyst	Challenge 2: Risk Aversion	B-The Safe Path	A-Turn the Tide of Public Opinion	C-Strengthen the Evidence	B-The Safe Path
	2: Innovative Culture Score:	2	6	5	2
	2: Innovative Solutions Score:	5	3	6	4
	2: Goal Attainment Score:	4	6	3	7
	Group Number	2	3	5	4
	Challenge 3: The Future Life of the Project	A-The Danish Health and Medicine Authority	B-The Power of Positive Example	B-The Power of Positive Example	A-The Danish Health and Medicine Authority

APPENDICES

	3: Innovative Culture Score:	1	8	7	1
	3: Innovative Solutions Score:	5	3	6	4
	3: Goal Attainment Score:	6	7	4	9
	Phase 6: Time to Complete	16:00	12:51	12:38	12:08
Final	Pre-Final Score	4	6	6	4.67
	Final Time:	1:04:25	48:47	1:06:45	56:45
	Final Delay Count:	3	4	2	4

APPENDICES

APPENDIX N: CO-CREATOR PRE-PLAY INSTRUCTIONS (REVISED)

Revised Co-Creator Pre-Play Introduction

Both Versions:

- Playing the game, Co-Creator
- Co-Creator is designed for professionals to teach them how to perform better in innovative processes
- The game is played by project managers or other participants in innovative projects
- The game was developed using studies on the Danish public sector, but it relates to other sectors as well
- People play to become better project managers or participants in co-creative, collaborative innovation projects
- In a real world scenario, you might be colleagues or together at a workshop or conference, also used at universities, or various other groups, so you should be able to participate and learn something

Non-Blended Environment (Low Stress):

- Looking at usability of tokens on resource cards
- Have fun
- Everyone will get a prize at the end

Blended Environment (High Stress):

- Assessing skills
- Assessing ability to come up with innovative solutions in a group setting
- Assessing final score as well as decisions throughout the game
- Tracking game decisions and movements
- Winning the game in comparison to other groups playing will result in a prize

Additional Game Instruction:

- Playing Co-Creator should take approximately 1-1.5 hours
- Carefully read through instructions while playing
- Skip all of the sections labeled “Back to Reality” in the instruction manual (in Phase 3,5,7)
- For ease of use, please use tokens to mark how much of each resource you have. When you need to take a resource from the bank, place a token on the corresponding resource card instead of taking a new card as the manual instructs.
- The manual says that the tokens to keep track of the score are red, but in this version they are black
- As our sponsor wants the games to be stored in a certain way, please leave everything where it is when you finish playing. No clean up required.
- Any questions?

APPENDICES

APPENDIX O: CO-CREATOR PILOT TEST ROUND 1 RISK RANKING

Risk Ranking: Initiator Challenge 1			
Group/Participant from Round 1 of Pilot Tests	Solution A - Internal Staff Working Paper	Solution B - Clear Mandate	Solution C - Common Narrative
1	3	1	2
2	1	3	2
3	2	3	1
4	3	2	1
5	3	1	2
6	1	3	2
7	3	1	2
8	1	2	3
9	1	3	2
10	1	2	3
11	3	1	2
12	2	3	1
Average	2.00	2.08	1.92

Risk Ranking: Initiator Challenge 2			
Group/Participant from Round 1 of Pilot Tests	Solution A - Staying with Operations	Solution B - Mobile Secretariat	Solution C - External Project Office
1	1	3	2
2	1	3	2
3	1	3	2
4	1	3	2
5	1	2	3
6	2	3	1
7	3	1	2
8	3	1	2
9	2	3	1
10	1	2	3
11	1	2	3
12	1	3	2
Average	1.50	2.42	2.08

APPENDICES

Risk Ranking: Initiator Challenge 3			
Group/Participant from Round 1 of Pilot Tests	Solution A - Seminar	Solution B - Town Hall Meeting	Solution C – Workshop
1	3	2	1
2	3	2	1
3	3	2	1
4	2	3	1
5	2	3	1
6	2	3	1
7	3	1	2
8	2	1	3
9	1	2	3
10	1	2	3
11	1	3	2
12	2	3	1
Average	2.08	2.25	1.67

Risk Ranking: Facilitator Challenge 1			
Group/Participant from Round 1 of Pilot Tests	Solution A - External Consultant	Solution B - Field Trip	Solution C - If You're Not with Us...
1	2	1	3
2	1	2	3
3	2	1	3
4	1	2	3
5	1	3	2
6	2	1	3
7	2	1	3
8	1	2	3
9	2	1	3
10	1	2	3
11	1	3	2
12	1	2	3
Average	1.42	1.75	2.83

APPENDICES

Risk Ranking: Facilitator Challenge 2			
Group/Participant from Round 1 of Pilot Tests	Solution A - Customize the New Technology	Solution B - Dispensation	Solution C - Breaking the Law
1	2	1	3
2	2	1	3
3	1	2	3
4	1	2	3
5	1	2	3
6	1	2	3
7	1	2	3
8	2	1	3
9	1	2	3
10	1	2	3
11	2	1	3
12	1	2	3
Average	1.33	1.67	3.00

Risk Ranking: Facilitator Challenge 3			
Group/Participant from Round 1 of Pilot Tests	Solution A - Involve the departments	Solution B - Focus on Operations	Solution C - The Hard-Line Approach
1	1	2	3
2	1	2	3
3	2	1	3
4	1	2	3
5	2	1	3
6	2	1	3
7	2	1	3
8	3	1	2
9	2	1	3
10	1	2	3
11	2	1	3
12	2	1	3
Average	1.75	1.33	2.92

APPENDICES

Risk Ranking: Catalyst Challenge 1			
Group/Participant from Round 1 of Pilot Tests	Solution A - All Ahead	Solution B - Reboot	Solution C - New Project
1	1	2	3
2	1	2	3
3	1	2	3
4	1	2	3
5	1	2	3
6	1	2	3
7	2	1	3
8	3	1	3
9	1	2	3
10	2	1	3
11	1	2	3
12	2	1	3
Average	1.42	1.67	3.00

Risk Ranking: Catalyst Challenge 2			
Group/Participant from Round 1 of Pilot Tests	Solution A - Turn the Tide of Public Opinion	Solution B - The Safe Path	Solution C - Strengthen the Evidence
1	2	1	3
2	3	2	1
3	3	1	2
4	3	1	2
5	1	2	3
6	1	3	2
7	2	1	3
8	3	1	2
9	1	3	2
10	2	3	1
11	3	1	2
12	1	2	3
Average	2.08	1.75	2.17

APPENDICES

Risk Ranking: Catalyst Challenge 3			
Group/Participant from Round 1 of Pilot Tests	Solution A - The Danish Health and Medicine Authority	Solution B - The Power of Positive Example	Solution C - Rinse and Repeat
1	2	3	1
2	1	2	3
3	3	2	1
4	3	2	1
5	3	2	1
6	2	3	1
7	1	2	3
8	3	1	2
9	3	2	1
10	1	2	3
11	3	2	1
12	3	2	1
Average	2.33	2.08	1.58

APPENDICES

APPENDIX P: CO-CREATOR INTERVIEW QUESTIONS (REVISED)

Review Co-Creator Interview Questions

1. Did you enjoy playing Co-Creator?
2. Which parts or aspects of the game made it enjoyable?
3. Which parts or aspects of the game did you not find enjoyable?
4. How was playing the game as a group?
 - a. Did you agree or disagree with the decisions made?
 - b. How comfortable were you with the other players?
5. Was the camera distracting?
6. Did knowing that you were being filmed impact the decisions you made? If so, how?
7. For blended: Did knowing that your moves were being tracked impact the decisions you made? If so, how?
 - a. Do you think that it influenced whether or not you chose riskier cards?
8. On a scale of 1 to 5, how easy was it to identify which solution would give you positive or negative results (1=easy, 5=difficult to discern). Can you explain your ranking?

Interactive Task: Pile sort each Challenge Card's Solutions (A, B, C) according to riskiness (ie. 1-lowest, 2-medium, 3-highest)

APPENDICES

APPENDIX Q: CO-CREATOR INTERVIEW CODED RESPONSES

Group Number	Blended/ Non-blended	Did you enjoy playing Change Navigator?		Which parts or aspects of the game made it enjoyable	Which parts or aspects of the game did you not find enjoyable?
		(Generally yes)	(Generally no)		
1 (WPI Students)	Non-blended	X		Unpredictable, Instant gratification	
2 (WPI Students)	Non-blended	Fun		Realistic, real problems, new perspective, investment and then reward or loss, goals and results listed, players liked the blocks on the game for resources	Reading, listening to others read, picking stakeholders- so many cards, didn't understand take resource on stakeholders (give away resources or receive new ones)
3 (WPI Students)	Blended	X		Easy to play, enjoyed collaboration, related to the real world	Stress!! No good options?
4 (WPI Students)	Blended	2 players yes-cool, I really liked it, would play again	3 players-no, was not entertained, did not enjoy playing the game	Liked that the leader and reading got passed around so no one dominated and everyone was engaged, liked the setup of options 2 reasonable ones and one really risky one, really easy to understand, well organized, easy to follow layout of board, liked multilayered decisions surrounding selecting stakeholders	too much reading, not entertaining, inconsistent labeling, typos, playing the game, running out of resources, didn't see the value in the game, nothing super challenging, just played numbers and managed resources- I have games on my phone that do this, it was boring and repetitive because the rounds were the same-stopped caring, not a good variety of decisions, should have a been a create your own option, options were two extremes, general frustrations with the limitations of the game, outcomes were too predictable, not challenging, disagreed with game options because didn't align with experiences, not enough opportunity to disagree, obvious best solutions
5 (CBS Students and Business Professionals)	Blended	yes, "I think it was fun", would be more fun if I played again because I would spend less time learning how to play		Very interesting to listen to other people's opinions, interesting to others, getting to know other people favorite part of game, whether I won didn't matter, arguments were a good learning part, discussing, time limit posed a challenge in a good way, concise	lots of reading, took a long time to figure out how language was used, significance of resources unintuitive, decisions, resources didn't reflect what I thought, time limit constrained learning, what the resources meant didn't have much significance, want more feedback at end and to record moves so they could compare their performance to others
6 (Danish School of Education Students)	Non-blended	yes, more later in the game once we understood how to play better		real life examples, based around things that could actually take place instead of hypothetical, intriguing questions that required reflection, intriguing and shocking solutions, fun having to prioritize resources	didn't take on roles well, outcomes didn't match expectations, couldn't contextualize things well, choices depended too much on the availability of resources

APPENDICES

Group Number	Blended/ Non-blended	What improvements do you think could be made to Change Navigator?	How was playing the game as a group?		Did you agree or disagree with the decisions made?	
			(Generally good)	(Generally bad)	(Generally agreed)	(Generally disagreed)
1 (WPI Students)	Non-blended	Better translations, digitally keep track of resources	X		X	
2 (WPI Students)	Non-blended	Collaboration/Cooperation on match on board and cards, explain block resources better, more specific about story, make it available for everyone to read along (own copy)	Good, minor disagreements but were worked out without arguing		Mostly agreed, agreed to disagree on a few, good that it was odd because 3-2 sometimes on yes vs no,	
3 (WPI Students)	Blended	The English translation was bad, delays made seriously no sense, the penalties for delays were too vague, cards explained better in general	X		X	
4 (WPI Students)	Blended	Add complexity, not enough opportunities for innovative solutions, improve value of playing game/replay value, add more stakeholders, stakeholders should change throughout, big flaw- going through game to get a good score, not about going through experiences	X-liked this pandemic everyone playing against game, not trying to screw each other, a good way to bond while still relevant to working, wanted to be competitive for my team, very collaborative-like playing as one person	because we agreed a lot, it didn't leave much opportunity for discussion, some people kind of led and didn't feel like disagreeing, would have been better if you worked independently and then came together so you had time to think on your own	almost always agreed	
5 (CBS Students and Business Professionals)	Blended	N/A		better than playing alone, fun part, more about group than actual game, Lots of focus on how to make a decision our process, didn't reflect too much on how we decided – not always in real life do you step back and reflect on how we decided	there were disagreements but didn't disagree with the final choice selected because democratic, never totally against view, no options really a bad option, so even if decision against, fine, voice was heard and others were heard,	

APPENDICES

Group Number	Blended/ Non-blended	What improvements do you think could be made to Change Navigator?	How was playing the game as a group?		Did you agree or disagree with the decisions made?	
			(Generally good)	(Generally bad)	(Generally agreed)	(Generally disagreed)
6 (Danish School of Education Students)	Non-blended	N/A	good, familiar with each other, felt free to ask each other questions, thought that the game might not go as well with a group of strangers		agreed to disagree	

Group Number	Blended/ Non-blended	How comfortable were you with the other players?	What aspects of the game did you find realistic or unrealistic?		Was the camera distracting?	
			(Generally realistic)	(Generally unrealistic)	(Generally yes)	(Generally no)
1 (WPI Students)	Non-blended	Cozy		X (What is telemedicine?)		x
2 (WPI Students)	Non-blended	Comfortable because they know each other	Situations	Delay aspect could be more in depth, delay consequences didn't come until end but in real life would be seen sooner, getting +1 -1 in game,	Had to watch what they were saying, sometimes didn't want to be in video, would sometimes forget though, if only looking at game board might be less weird, if they knew that it was being watched by more people they might be more distracted	
3 (WPI Students)	Blended	Cozy	The scenario, the responses and the situation presented	Breaking the law = good?	Yes, it was, but they said it has less of an effect the more they played	

APPENDICES

Group Number	Blended/ Non-blended	How comfortable were you with the other players?	What aspects of the game did you find realistic or unrealistic?		Was the camera distracting?	
			(Generally realistic)	(Generally unrealistic)	(Generally yes)	(Generally no)
4 (WPI Students)	Blended	everyone comfy	breakdown of resources realistic	best solutions didn't match personal experiences, if you have innovative culture no innovative solution, disconnect between innovative culture and innovative solutions, how are we attaining goals without innovative solutions, ability to pick and choose balanced resources unrealistic-usually take what you can get not pick of what you want, stakeholders change more often throughout the project, the choices we made with stakeholders not represented well/reflected well throughout the game	I looked at myself a lot, looked at posture, distracting in that way, used to look at time-clock going was helpful, kind of annoying but not detrimental to decisions, felt self-conscious about posture/appearance made it less comfortable experience	
5 (CBS Students and Business Professionals)	Blended	were comfy	N/A	N/A		all no, only fan noise
6 (Danish School of Education Students)	Non-blended	comfy, knew each other prior	N/A	N/A		no, didn't notice

Group Number	Blended/Non-blended	Did knowing that you were being filmed impact the decisions you made? If so, how?		On a scale of 1 to 5, how easy was it to identify which action cards would give you positive results	
		(Generally yes, explain how)	(Generally no)	Rank	Explain your ranking
1 (WPI Students)	Non-blended		X	4	Often times there was an outcome that was not expected or the best choice based on outcome didn't seem like a good idea.

APPENDICES

Group Number	Blended/Non-blended	Did knowing that you were being filmed impact the decisions you made? If so, how?		On a scale of 1 to 5, how easy was it to identify which action cards would give you positive results	
		(Generally yes, explain how)	(Generally no)	Rank	Explain your ranking
2 (WPI Students)	Non-blended		No	3	"terrible" solutions sometimes had great results, 50/50 thought it was going to go one way and right and otherwise wrong, based on own experience,
3 (WPI Students)	Blended		They claimed it did not	3	It was difficult to know what the best option would be and some cards that seemed really bad ended up giving very positive results
4 (WPI Students)	Blended	some felt that knowing that moves were being tracked though prevented us from cheating	X camera didn't influence decisions, didn't care as much because peers (not an authority) was watching me, regardless-excited about taking risk, and working of card gave away which solution would give no points, nothing super risky, no one important like a boss was watching me so I didn't really care	4	unanimous, we agreed on pretty much everything
5 (CBS Students and Business Professionals)	Blended		unanimous no, "might be different if your boss is filming you while you're doing this, I really don't care, I could imagine that for other people in other settings it might matter"		problem with question since solutions were not positive or negative, did not find it easy to figure out which would help you, but weren't really sure, didn't understand point of game...quite difficult 4/5, Not so hard to see which aspect it would affect, but hard to see extent it would affect
6 (Danish School of Education Students)	Non-blended	"I think always people act a little differently if they know there is a camera" "maybe you would have		3	Difficulty discerning – easy to identify this was a good solution but not know the outcome, 3 – thought oh you could choose what ever,

APPENDICES

		thought twice about certain things or decisions" said they would not have done the breaking the law card, maybe, "if we had known there was a camera maybe we wouldn't have been arguing, but all speculation, may not have been so aggressive with each other			could see what would give certain score parameters
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APPENDICES

APPENDIX R: QUESTIONNAIRE: LIKERT-TYPE FREQUENCY BREAKDOWN

"Blended" Frequency Breakdown						
		Question #				
		38	39	40	41	42
Likert Score	1	0	0	1	0	0
	2	2	1	1	0	0
	3	2	4	6	1	4
	4	4	4	1	4	5
	5	2	1	1	5	1

Non-Blended Frequency Breakdown						
		Question #				
		38	39	40	41	42
Likert Score	1	0	1	2	0	1
	2	0	0	2	1	1
	3	3	5	3	3	2
	4	7	4	3	5	5
	5	0	0	0	1	1