Preventing a POX Among the People? A Design Case Study of a Public Health Game

Mary Flanagan, Max Seidman, Jonathan Belman, Sukdith Punjasthitkul, Zara Downs, Mike Ayoob, Alicia Driscoll

Tiltfactor Laboratory, Dartmouth College
HB 6194, 301 North Fairbanks
Hanover NH 03755
603 646 1007
mary.flanagan@dartmouth.edu; Maxs@dartmouth.edu;
sukdith.punjasthitkul@dartmouth.edu; jonathan.belman@gmail.com; Zara@tds.net;
mytoesaregettingpruny@gmail.com; alicia.a.driscoll@gmail.com

Martin Downs

Mascoma Valley Health Initiative
Martin.Downs@MVHI.Org

ABSTRACT

The POX: Save the People game was developed to address some of the core concepts included in curricular frameworks for Science Literacy in the USA. This paper documents our design research, design approach, and prototyping process.

Keywords

Health games, board games, prototype, analog to digital, systems thinking, transfer

INTRODUCTION

Can a board game shape opinion and affect argument through its design? These are theories discussed in game studies circles, are frequently empirically validated. If they do affect opinion and argument, how exactly do they do it? Further, in regards to the design of a game, how does a board game properly abstract scientific fact so that players come to clear understandings that are not filled with scientific misconceptions? In other words, how does science knowledge transfer from a board game to players? What are valid ways for the collection and analysis of such data? Our team recently created a board game designed to educate players about the role of vaccination in public health.

CONTEXT

This paper describes our work on the game, called POX: Save the People. Martin Downs, the Director of Public Health Programs at Mascoma Valley Health Initiative (New Hampshire, USA) came to the Tiltfactor Laboratory and asked if we could design a game

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that would give players a better understanding of "herd immunity." As many people in the international community are aware, communicable diseases are infections that can be passed from one person to another. Immunity to a communicable disease means that the body has defenses against that disease, so that a person doesn't become infected if they are exposed to the disease-causing organism. Immunity can be conferred by a past infection or by vaccination.

Even though most children in the United States receive all recommended vaccines, many under-immunized children remain, leaving the potential for outbreaks of disease. Often, adults are under-immunized as well, missing opportunities to protect themselves and others against vaccine-preventable disease [2]. The effect whereby unvaccinated people are protected by the immunity of others in the population is known as "herd immunity" [9]. Herd immunity exists when people without immunity to a certain disease are protected indirectly by being surrounded by people who are immune. If a high percentage of the population is immune, the entire population is protected because the disease has little opportunity to spread. That is, an infected person is unlikely to have contact with a susceptible person and pass on the disease. If a lower percentage of the population is immune, there are more opportunities for the disease to spread. Herd immunity works by reducing a disease's ability to spread to others. Herd immunity can be established if enough people are vaccinated.

Creating herd immunity is an important goal because it's never possible to vaccinate 100 percent of the population. For example, some vaccines cannot be given to pregnant women, people with weakened immune systems, or people who are allergic to components of the vaccine. Babies, too, cannot get certain vaccinations before they're several months old. What's more, no vaccine is 100 percent effective. Vaccinations fail to confer immunity in a small percentage of those vaccinated. Some people may also choose not to be vaccinated. Others may not have access to vaccinations, or they may not even know about vaccinations they could have. Establishing herd immunity is a vital step towards protecting people who, for any of these reasons, do not receive vaccinations.

The threshold required for herd immunity to be established varies depending upon the disease. For example, to create herd immunity to measles in the United States, 83 to 94 percent of the population must be immune [3]. Here are a few estimated percent-of-population thresholds for herd immunity for other diseases:

Diphtheria -- 85 percent
Mumps -- 75 to 86 percent
Pertussis (whooping cough) -- 92 to 94 percent
Polio -- 80 to 86 percent
Rubella -- 83 to 85 percent
Smallpox -- 80 to 85 percent

In the United States and other developed countries, immunity to these diseases is maintained at a high level by universal vaccination of the population (except for

smallpox, a disease that has been globally eradicated; thus smallpox vaccination is now limited to a small number of people). As a result, these diseases, which were common in the early part of the 20th century, are now very rare or nonexistent. No one in the United States is infected with polio anymore, although
the disease is still circulating in other parts of the world where sufficient herd immunity to the disease has not been established.

Smallpox, one of the most devastating diseases in all of human history, was officially eradicated worldwide in 1980, which wouldn't have been possible without mass vaccination. Several countries have eliminated measles and polio, meaning that these diseases are no longer endemic, or constantly present, in that country. Some diseases have been entirely eradicated across the whole world. Nevertheless, we may have lost our herd immunity to pertussis, because it appears now that immunity given by childhood vaccinations wears off over time, leaving many adults susceptible to the disease once again, and pertussis rates in the United States are on the rise.

The very low levels of infectious disease to which we have become accustomed would be jeopardized if current vaccination coverage rates were not maintained [7,10]. Research has shown that failure to maintain herd immunity thresholds through vaccination has led to recent epidemics of measles. For example, in 2003, measles was introduced by a single infected tourist to the Marshall Islands, a small Pacific island nation, where the measles vaccination rate was only 75 percent -- well below the herd immunity threshold. More than 700 people in this country of 56,000 fell ill; dozens were hospitalized, and three died. The same year, measles was twice introduced to Mexico, which had a measles vaccination rate of 95 percent. Only 41 people in the country of more than 100 million contracted measles.

Nevertheless, high vaccination coverage is threatened by numerous forces, including an influential anti-vaccination movement that promulgates misconceptions and misinformation about vaccines, and lack of concern about vaccine-preventable diseases among those who have never experienced them [8]. Education about the concept of herd immunity and the importance of vaccination is needed to strengthen support for and acceptance of routine vaccination of the population.

DESIGN APPROACH

We began work on the game in Summer 2010 and completed design in 6 months.

Design Goals

Our team decided early on that the game needed to be what we call a "collaborative strategy game." Focusing on the vexing question of how to reward players in collaborative and co-operative games, we had to decide early on that it would be inappropriate for the game to feature a "hero" character or some other individual who would "win" by preventing disease in a community. In order to communicate the message of the game, community health is unlikely to be thought of in terms of winners and losers through the lens of public health. Every unvaccinated person harbors a potential threat to harm the whole group. Therefore the team, informed by our prior work in Values at Play and the incorporation of human values in games (see [6]) decided to alter traditional game goals to formulate a game in which the outcomes would be constituted without typical reliance on single winner take all outcome, for such a play outcome in the vocabulary of public health tends toward considering health crises such as an outbreak of a virus as negative for the entire community. This is an ethical choice as well as a game goal [11].

Second, the team decided to represent people in the game in favor of showing geographic areas, realistic cities, or nations. This was in part based on our past research in empathy in games [1], and in part based on the need to show how any contagious disease can spread, regardless if it is in one country or another, or regardless if it is in the city or in a rural environment. Abstracting the space allows players to move away from literal interpretations of the phenomenon (i.e. people are sick in this location only) to better emphasize disease spread as a phenomenon that happens in any place.

Third, we wanted to foster critical thinking through critical play [4] and by creating a system that would stir debate and would be open to interpretation [5]. The abstract nature of the board allows players to focus on the phenomenon of disease spread, not on the surrounding debates about the issue. If a technology is the making and use of tools, techniques, and methods of organization in order to solve a problem or serve some purpose, games are themselves technologies of meaning making. Yet importantly, they are also experiences that are sharable, social, and experimental, meaning players may take on different tactics and strategies to see how their choices manifest. Any interesting game generates complexity through player choice and manifests that in a meaningful space of agency.

When we prototyped the first version of the game, our team's aim was to create something as lightweight as possible, so we started with several cards and many temporary boards.

Figure 1: The Tiltfactor team trying out an early prototype. Shown from Left: Alicia Driscoll, Max Seidman, Mike Ayoob, Mary Flanagan.

The second version of the game was created in a hex format, following the format of popular tabletop role-playing games such as Warhammer. We used placeholder art for the characters and calculated the random drop of a contagion outbreak through a computer program designed by team member Seidman. The virus spread across the board from these initial contagion points through a spinner that noted the direction of the hex to next infect.

Figure 2. An Initial HEX shaped board

These placeholder graphics represented humans we used to illustrate the person-by-person spread of a given infectious disease. In this edition, some players, unfamiliar with the hex format, found the directional movements more confusing, though our team liked the six degrees of possible movement that an illness could take.

We later switched to a grid format to make game play easier. We then chose to standardize the human characters on the board and abstract them, for two reasons. First, we did not wish to mislead players to think that some human characters were more prone to illness than others simply by the way they looked. Second, if the characters were more abstract, and the board simplified graphically, the players could see the illness spread across the board through the colors of vaccination and illness – thus, actions from game play would have more of a presence on the board, with the double functionality of making the game moves more like a scientific visualization. We found that in making the graphics abstract, players could concentrate on looking at trends on the board, the waves of colors in disease outbreaks.

Balancing the game proved tricky. Could the contagion spread in multiple directions? How many players per turn could be immunized against the contagion? How many could be cured? How quickly does a disease move through a population?

Figure 3: A critique from MVHI

Design Challenges

In designing the analog version of the game we encountered several challenges where the game mechanics were tweaked to be true to the message of the game.

1) In the early prototypes through the final game, POX was designed to have "outbreaks," allowing the disease to pop up on a healthy person away from the center of the spread. This mimics the way in which a traveler might fly home with an illness, or a hospital worker may accidentally contract an illness and infect their household. We initially designed the outbreak mechanic (which places new diseases in healthy areas of the map) to be placed randomly. Initially, the locations of these outbreaks were determined by rolling dice and using a coordinate system; they were random. We were not able, however, to find an easy method to generate the random illness outbreak drop-point that players did not find slow or clunky, and so we compromised by allowing players to choose the space in which the disease broke out, within certain limiting parameters. This particular mechanis would more accurately represent actions like the dumping of toxic waste (since it must be placed somewhere, and humans choose where to place it), yet we found that the shift to "playing the disease" for one turn did not feel strange to the players. The response to our game mechanics of placement and spreading of disease was positive players.

2) In the early stages of POX, the initial game state (how the board looked at the start) was randomly generated. Again, this proved problematic for players, and in the end we opted to have the initial game state fixed, decreasing replayability in order to increase ease of play.

3) A key challenge was what determines a “win” and “lose” state. Throughout the design we struggled with deterministically deciding when the players had reached an end state – in other words, when they had “won”. What constitutes winning in such a game? Eradicating disease, vaccinating everyone, containing outbreaks? The ideal end state would be when the disease can no longer infect any new people, but because it can propagate in two ways (spreading from existing disease and outbreaking onto 'random' people in healthy zones), it was impossible to expect human players to check whether or not every space was safe each turn. In the end we decided that the players win when the disease could not spread from any existing disease, but could still outbreak on new spaces. This compromised ease of play with the occasional game in which the players could win before they actually had the disease under control.

4) One additional challenge was to stay within a believable level of scientifically accuracy: our goal was to simulate actual vaccination rates within a community (e.g., 83-94%) in game. Early playtests showed, however, that this nearly ruined the game play. We could set the end state of the game so final immunization rates were close to realistic, but to achieve this, players had to spend many turns once the disease was under control simply vaccinating and curing people with no chance of losing. In the end, we decided that quantitative accuracy in this regard was less important to represent than the other mechanical concepts.

PRODUCTION

We wanted to use novel materials for the game production so that players enjoyed the tactile experience of the game. We designed a playmat for game board. Playmats are fabric and a rubber-like foam sheets, like very thin mouse pads, that are commonly used by players for Magic the Gathering card games. They are flexible, washable, and allow for more unusual packaging ideas.

Figure 4: POX: Save the People Market Release v. 1.0

For exterior packaging, we used plastic tubes, which looked great, were different than traditional game boxes, and were more affordable for small numbers of games than the alternatives. Our team assembles the game components—board, tube, instructions, cards, and chips -- and we ship the game ourselves.

FINAL GAME OVERVIEW

POX: Save the People is a turn-based game for 1-4 players that models the spread and prevention of contagious disease in a community. Players work alone (in the case of one player) or together to get the disease under control by vaccinating the “healthy” people on the board, one by one, and curing them if necessary. But disease strikes! Players add pieces to the board in order to create conditions where no disease can spread.

How it works

The game begins with two drop points for infection on the board, simulating two people falling ill from a contagious illness. These points are centrally located on the board (see figure 4). A card is drawn, dictating the action of the infection – the infection either spreads to other people in a direction given on the card, or there is a new outbreak of the disease somewhere on the board. If the disease is spreading, players can choose to immunize three uninfected people, or use all of their resources this turn and cure and vaccinate someone who has already fallen ill.

The goal of the game is to stop the spread of illness and in particular stop deaths in the community. When a red, infected piece is surrounded on all four sides by red infected pieces, the surrounded person "dies," and their space is covered in black. Players choose at the beginning of the game how many deaths they can allow; often, this depends on their level of experience, but it is also in part left to chance.

During game play, players discuss risks vs. rewards with each other. In our playtesting, players find themselves trying to predict where the disease is going to spread—where the game has created the most dangerous spots. They said such things as “"Better to lose that one than risk the infections becoming out of control."

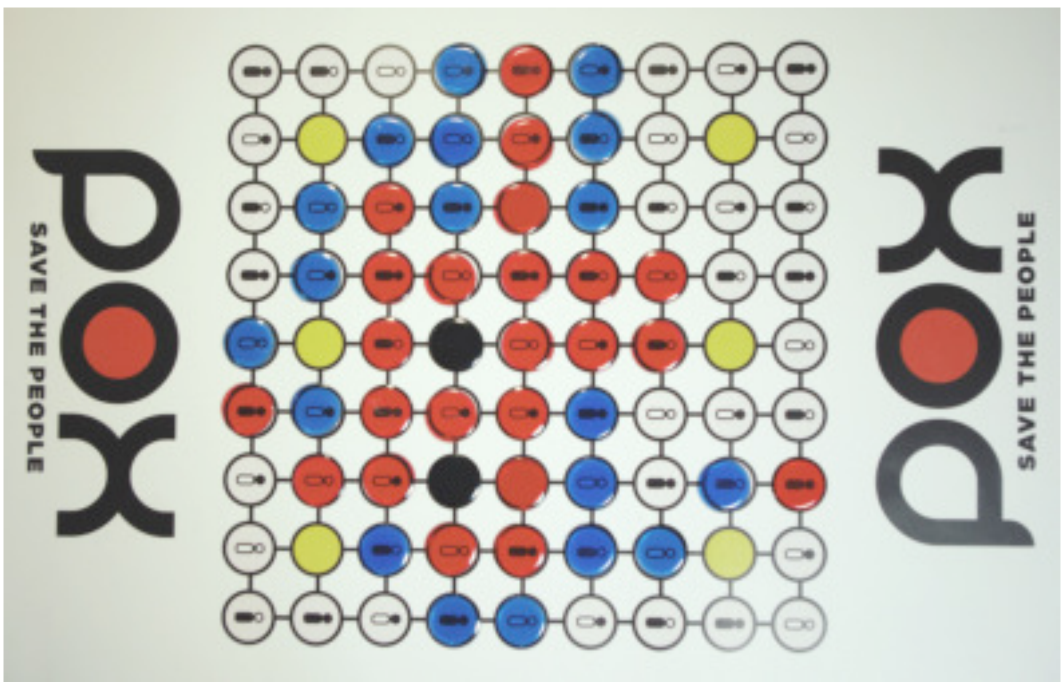

Figure 5: A Game in Progress

Yellow spots on the board represent those who are immuno-compromised and cannot receive a vaccination, such as pregnant women, HIV positive patients, the elderly who have weakened immune systems, or young infants. In the game, when these people are infected through disease spread, they die immediately. Obviously this is not entirely the case in the real world, but this game play necessity did help players use hightened caution around those with compromised immune systems. By playing the game, players begin to understand the choices in preventing communicable disease. By deciding who to immunize and who to cure, students will experiment with the implications of disease control on the community as a whole.

STUDY

We have been studying the potential for the game to teach systems thinking, and recent results have shown much promise in this area. The assessment of the game was focused on two questions for the board game version: First, did the game impart systems-level understandings of the relationships between vaccination, disease and public health? Second, were players able to transfer what they learned in the game to a problem in a domain lying outside of the game? Our results suggest that, although participants did not demonstrate complete systems-level understandings, they did achieve significant shifts in the direction of system-level understanding. With respect to transfer of learning, all participants were able to apply concepts in the game to a hypothetical public health problem that was presented to them after play. They were able to do so without the guidance or strong hints that are often used to encourage transfer in cognitive and learning science research. These highly useful results will be published in detail in a forthcoming journal publication.

THE DIGITAL GAME

In transforming POX into an online digital game, some of the team's design choices had to be reconsidered, due to the computer's ability to generate pseudo-random numbers with ease (for cases 1 and 2) and their ability to moderate play (for case 3).

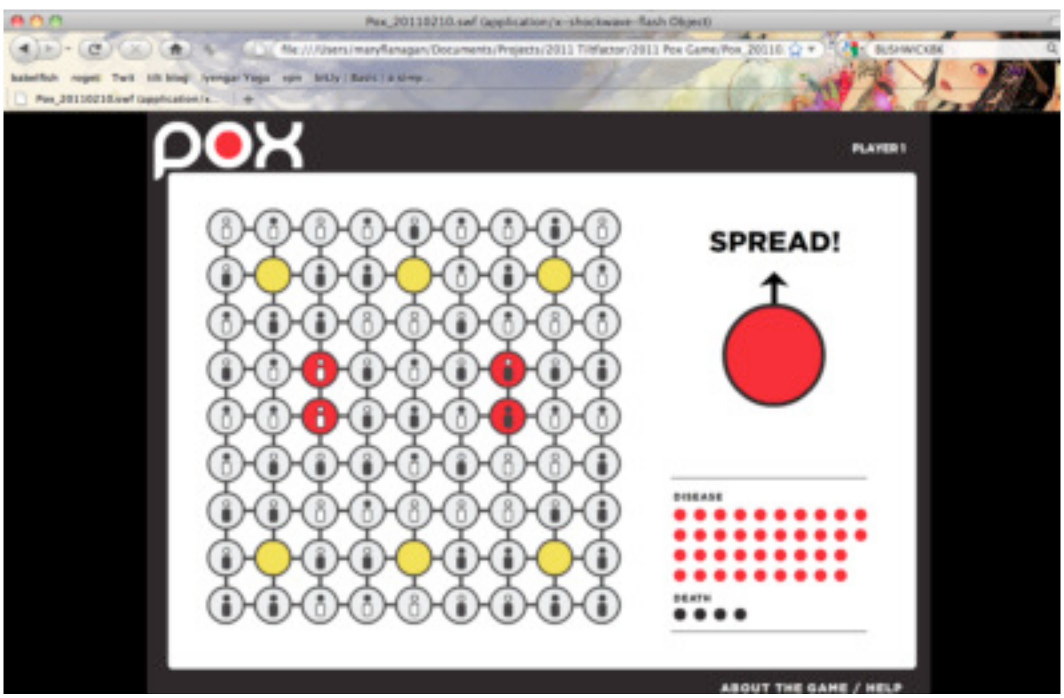

Figure 6: Digital version (online) of POX

For each of the considerations we had to weigh the benefits of staying true to the disease simulation as we had wanted to initially, against staying true to the game we had already designed.

For each of the considerations we had for the analogue game, we had to take stock and at times arrange alternate solutions. For the outbreaks, we decided to keep the more inaccurate model of player-chosen locations over randomly generated ones in order to keep digital POX and analog POX similar games. For the initial game state, we chose the optimal solution and decided to allow players to choose "normal" mode (in which the board state was predetermined) or "advanced" mode (in which the board state was randomly generated). Finally, in creating anew the win state in the game, we decided that digital POX should deviate from its analog counterpart and end the game only when the disease could no longer propagate.

FUTURE

The team moved from creating a board game to creating a digital version of the game, and is in the process of assessing the game and its various transitions.

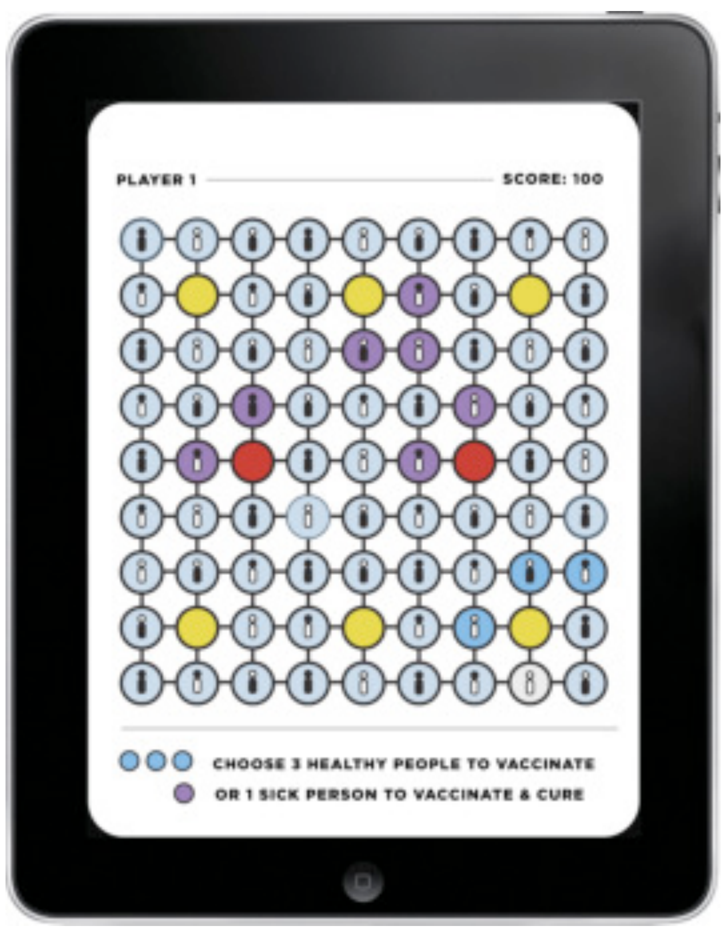

Figure 7: iPOX

CONCLUSION

We hope this document will help those researchers working in the area of health games create fun games while investigating cooperative game play and making sure game mechanics accurately reflect the core thematic elements of the content at hand. POX: Save the People teaches players how one might think strategically on a systems-level to immunize the populace to prevent diseases.

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