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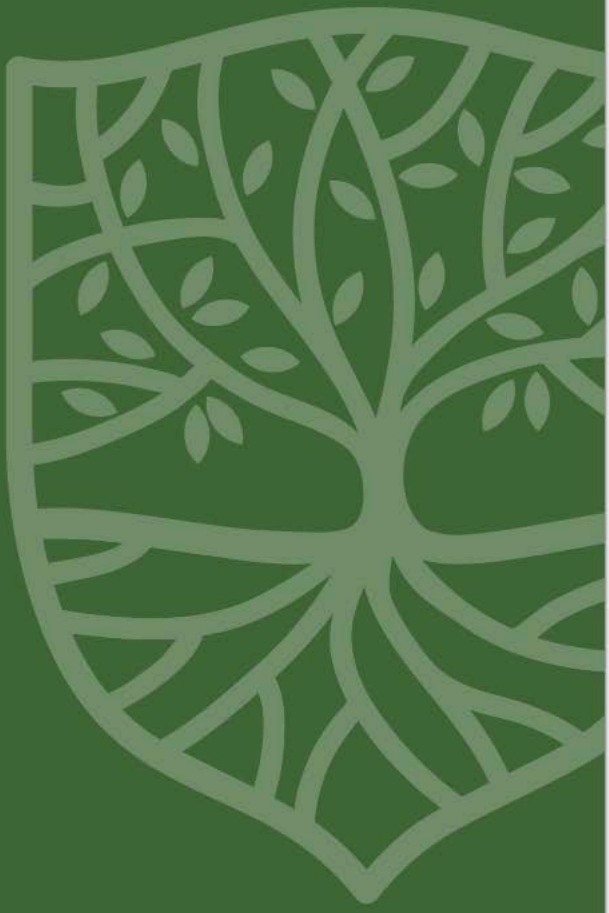

JOURNAL OF Games, Self, & Society

ithrive GAMES

Journal of Games, Self, & Society

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KELLI N. DUNLAP & SUSAN E. RIVERS,
EDITORS-IN-CHIEF

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Introduction to Issue 1

KELLI N. DUNLAP & SUSAN E. RIVERS, EDITORS-IN-CHIEF

In March 2017, the Higher Education Video Game Alliance (HEVGA) held a working group meeting in the days leading up to the Game Developers Conference in San Francisco. As a sponsor of the meeting, we were fortunate to participate and listen to the rich discussions about the state of the field of game studies in higher education. Of the many topics that surfaced was a need for more peer-reviewed, scholarly journals to serve as venues for learning and situating scholarship within this domain, providing publishing options for junior and senior scholars alike.

Being a new organization at the time, we at iThrive Games too had struggled with where to find individuals, labs, and studios who were pushing research, thinking, and design forward at the intersection of games, self, and society. To determine if this area of work was of interest to the field, we worked with ETC Press on a special issue of *Well Played*—volume 7, number 2—titled *A Special Issue on Meaningful Play and Games for Social and Emotional Learning.* We put forth this mission in that special issue:

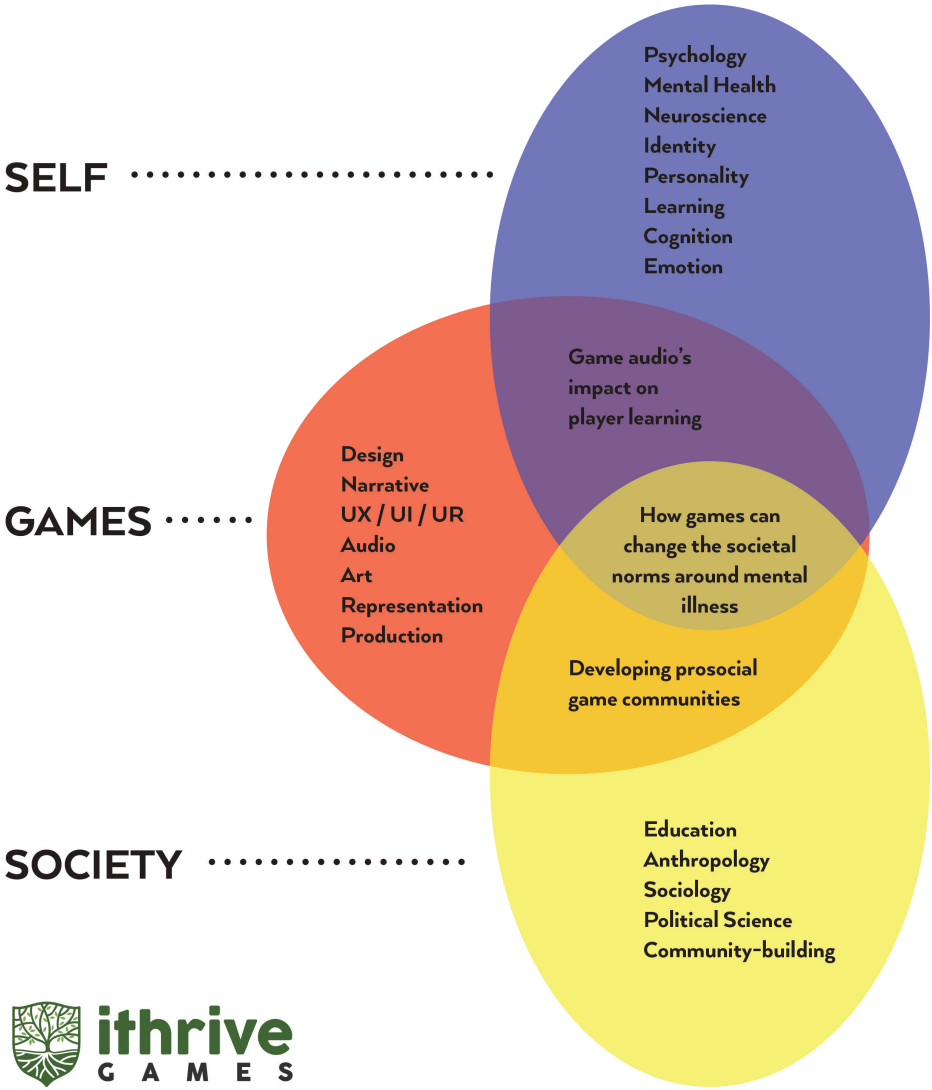
> "We hope to push the field forward by engaging with developers, scholars, and practitioners to innovate on design so that games provide meaningful experiences while maintaining the immersive, fun, and engaging qualities that make them compelling to play" (p. ix).

Interest was high in the special issue and we published six articles, following a blinded peer-review process. Reception to the special issue continues to be positive and enthusiastic with over 300 downloads in the

first two months. Due to this response, we decided to launch the *Journal of Games, Self, & Society*.

JOURNAL OF GAMES, SELF, & SOCIETY

Venn diagram of sample topics



The *Journal of Games, Self, & Society* is a peer-reviewed journal created and edited by iThrive Games, published by ETC Press. Reviewers are experts

from the fields of game design, game studies, education, and psychology. With the *Journal of Games, Self, & Society,* we intend to encourage multidisciplinary research, conversation, and community around games-related scholarship. The journal highlights work focused on how games, game design, and gameplay contribute to a deeper understanding of personal growth, learning, relationships, health, and humanity.

For the first issue of the *Journal of Games, Self, & Society*, we are proud to share a collection of papers that span fields of study from political science to interpersonal violence to STEM, and that share learning and insights in the realms of education, game development, physical health, relationship safety, and mental well-being.

In this issue, you'll find a paper by Ruud Jacobs, Ph.D., assistant professor in communication and technology at the Department of Communication Science at the University of Twente in the Netherlands, and professor Jeroen Jansz, Ph.D. and assistant professor Julia Kneer, Ph.D, in the Department of Media and Communication at Erasmus University Rotterdam, Netherlands. In their piece, *Playing Against Abuse: Effects of Procedural and Narrative Persuasive Games,* Jacobs, Jansz, and Kneer compare the effectiveness of narrative versus procedural mechanics at shaping player attitudes toward teen domestic violence, and suggest methods of examining similar effects in other games and contexts.

Edward Castranova, Ph.D., a professor of media at Indiana University, wrote *American Abyss: Simulating a Modern American Civil War.* This is a deep-dive into the design and dynamics of the game *American Abyss* as a tool in the classroom and beyond to help make accessible some of the complex systems and forces underpinning modern geopolitical conflict, including in the United States. Castranova provides details of the process of creating this game and insights for deploying it in educational settings.

Matthew Lee, R.N., M.S., co-founder and creative director at AFK studios as well as a Hillman Scholar for Nursing Innovation, and Kathleen Yin, BPharm, Ph.D., Postdoctoral Research Fellow at the Australian Institute of Health Innovation at Macquarie University, Australia, authored *When the Mind Moves Freely, the Body Follows – Exergame Design, Evaluation, and the Curious Case of Pokémon GO.* Lee and Yin provide an overview of the

health benefits of exergames as well as design principles for maximizing self-motivation. They analyze *Pokémon GO* as a case study examining the potential impact of games that get us moving.

In *Using Games to Support STEM Curiosity, Identity, and Self-Efficacy,* Lindsay Portnoy, Ph.D. and Karen Schrier, Ph.D., analyze game design practices for creating games that encourage and support students' STEM learning. They explore how supporting and developing social and emotional skills is critical to future performance in STEM fields. Portnoy is co-founder of the games studio *Killer Snails,* an author, and a lecturer at Northeastern University; Schrier is an associate professor of games and interactive media, director of the Play Innovation Lab and the Games and Emerging Media program at Marist College, and a Belfer Fellow with the Anti-Defamation League's Center for Technology and Society.

The *Journal of Games, Self, & Society* is intended to be an outlet for the exploration of how games and gameplay reflect and foster the intersection of self and society. We do not know where this road will take us, but we know that our companions on this journey necessarily include scholars, designers, educators, scientists, and players learning, playing, thinking, and innovating together, across disciplines and spaces. This work requires that we engage in the very concepts we hope to explore in this space, concepts like collaboration, empathy, civil discourse, compassion, forgiveness, courage, and creativity. We brought this journal into being to encourage and inspire multidisciplinary research, conversation, and community, and to foster greater connection amongst us in the development and use of compelling games that put humanity at their core.

Because of the still evolving scope of the journal and our emphasis on academic and professional rigor, we were only able to accept a small portion of the submissions we received for the inaugural issue. However, we want to strongly encourage people in a wide range of disciplines and research areas to submit for future issues and to suggest topics for special issues where the general scope of the journal may be focused on specific, or timely, concerns in the various communities we commit to support.

ACKNOWLEDGEMENTS

The launch of this journal would not be possible without so many inspiring and supportive humans. We appreciate Drew Davidson at ETC. We do feel like he's our biggest fan; his encouragement for creating this journal was just the fuel we needed for take off. Brad King's steadfast commitment to ETC Press is unmatched; Brad's willingness to respond to our endless questions and his openness to our ideas has made this first issue come into being. Doris Rusch is first among our muses; she inspires us to dig deeper and do the hard work that is required for the transformation we seek. We are tremendously grateful to the brilliant and kind members of our editorial board who routinely offer their guidance, support, and time. To all the authors who submitted their work to this first issue, thank you for jumping on board with the concept for this journal; please keep sharing your work with us and with the world. Dan Gardner served as our copyeditor; his masterful organization kept us grounded and on track and he can spot a misplaced comma at 1,000 paces. We wish him the absolute best in completing his doctorate. We are indebted to the iThrive Games team–Jane Lee, Cat Wendt, Michelle Bertoli, Trynn Check, Sean Weiland, and Sierra Martinez. This band of humans is unsurpassed in their commitment to our mission, dedication to advancing games, and kindness and compassion. The world is a better place because of who you are and what you do. And none of the work we do at iThrive, for this journal and for our other endeavors, would be possible without the generous support of the D. N. Batten Foundation and our visionary, Dorothy Batten. We are humbled by the trust she has in us to carry iThrive forward.

American Abyss

Simulating a Modern American Civil War

EDWARD CASTRONOVA, PHD

ABSTRACT

In recent years, speculation has arisen in the United States about the possibility of a civil war. Here I introduce a paper simulation of such a war using state-of-the-art lessons about modern civil war that have been developed within the diplomatic/military/intelligence conflict simulation community. According to those lessons, counter-insurgency (COIN) operations are a beastly mess for everyone involved. The simulation allows players to see why: In a modern intra-state conflict, there are many actors at play, each with their own access to the critical resources of media, money, and arms. These actors all have asymmetric aims, which lead to constantly shifting loyalties. The result is a conflict that is unlikely to end until all of the players are completely exhausted. I developed the simulation described in this paper as a warning to those who want to take up arms: Do not.

INTRODUCTION

In the United States, the early decades of the 21st century have proven to be a period of increasing internal tension. The period has seen a decline in confidence in democratic institutions (Pew Research Center, 2018). Incidents of political violence have become commonplace. In 2017, a congressman was shot at a baseball game (Savransky, 2017). Writers on all sides have begun to speak of civil war (Lang, 2017; Kreitner, 2017;

Wright, 2017; Vespa, 2018). Using violence to resolve conflicts seems to be increasingly appealing to an increasing share of the population (Villasenor, 2017).

If such a war were to come, do we know what would it look like? History has shown that when a people has not experienced war for a long time, they develop optimistic visions of it. Americans rushed to the colors in 1861, and Europeans cheered as their sons went to their doom in 1914. For contemporary Americans, *war* has become something that our troops do in a faraway dusty place. The last major battle on American soil was at Pearl Harbor in 1941. It is likely that those today longing for civil war in the U.S. harbor unrealistic expectations about its likely course. Perhaps some dream of a swift governmental overthrow, a putsch that quickly removes one form of rule with another. Others may dream of swift, targeted, armed government action to stamp out the bad movements in our midst (whatever those might be). Optimistic visions of war generally view it as bloodless, noble, and short.

War is nothing of the sort, of course. General Sherman said, "war is hell," and the blood, sins, and endlessness of contemporary civil conflicts do testify. The modern world provides many examples. Iraq has been in a state of near-constant internal warfare since 2003. In Syria, the government has taken to chemical weapons to overcome the resistance it faces. Northern Ireland was at war with itself for decades until the 1998 Good Friday Agreement finally brought peace. In the 1990s, Yugoslavia descended into barbarism, while Colombia saw fighting among several armed factions and drug lords. As of late 2018, the United States is still trying to pacify Afghanistan: 17 years and counting.

Government security forces around the world have had to wrestle with the many problems raised by this type of conflict. These operations have been labeled *counter-insurgency*, or COIN operations. A serious effort has been made to understand COIN dynamics, in their military, political, economic, social, cultural, and psychological dimensions. Game-like simulations have a long history in military analysis (Hill & Miller, 2017), and accordingly, a COIN-based approach to wargaming has been developed. COIN simulations have proven useful in illustrating just how complex and difficult modern civil war can be.

In this paper I discuss the application of COIN wargaming methods to a civil war simulation in the contemporary United States. The simulation is provided at two levels. First, a highly simplified version suitable for classroom exercises at the secondary school level and above (included in Appendix 1). This version is named *American Abyss: Student Edition.* Second, a far more complex version is available as a modification of an existing COIN wargame. This version, named *2040: American Abyss*, is based on a highly sophisticated simulation of the Colombian civil war in the 1990s. Playing this mod requires the base game *Andean Abyss* (Ruhnke, 2012), as well as the modification materials provided at the following website: https://edwardcastronova.com/portfolio/american-abyss/. The goal of the simulation, and the paper, is to allow players to experience what such a war would be like and provide enough insight, one might hope, that players and readers alike might dedicate themselves to preventing this unhappy thing altogether.

COIN OPERATIONS AND COIN SIMULATION

Counter-insurgency became a distinct type of operation as various militaries digested the lessons of the U.S. pacification efforts in Vietnam and similar Soviet efforts in Afghanistan. A shift in military thinking occurred, from nation versus nation thinking to faction versus faction thinking. Warfighting was no longer about locating and destroying the enemy force. It became about managing a complex situation so that the parties A) lost their will to fight and B) settled down into a situation that was desirable for the military actor doing the strategizing. The lessons of Vietnam and countless other examples revealed that pacifying a turbulent situation was about more than weapons. The military had to become familiar with a complex brew of non-military considerations, from public opinion to respect for the sacred.

The complexities of modern intra-state conflict are difficult to understand and convey, naturally. Figure 1 is a diagram of the second day at Gettysburg (Jespersen, 2011).

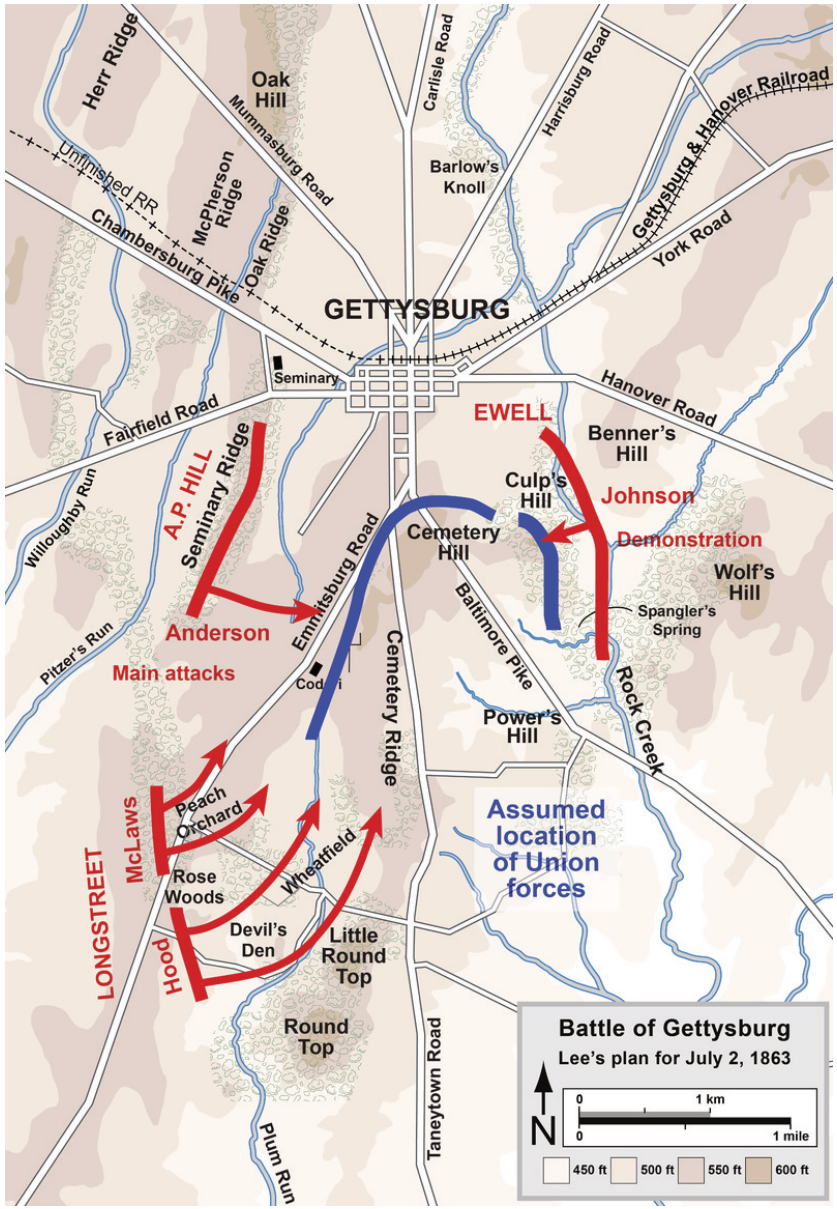


Figure 1. Lee's plan for Day 2 at Gettysburg. (Map by Hal Jespersen, 2011).

While the perceived complexity of the activity displayed in this image may depend on the viewer, it is unquestionably less complex than the diagram

featured in Figure 2, an attempt to summarize the forces at play in the Afghanistan counter-insurgency c. 2007 (Mail Foreign Service, 2010). From 30,000 feet, the message conveyed is clear: The quantity of actors, forces, and fields of conflict is almost innumerable. The resources and incentives of the actors are all at cross-purposes. It is not us versus them but rather all-against-all. One general is reported to have said, "When we understand that [diagram], we'll have won the war" (Mail Foreign Service, 2010).

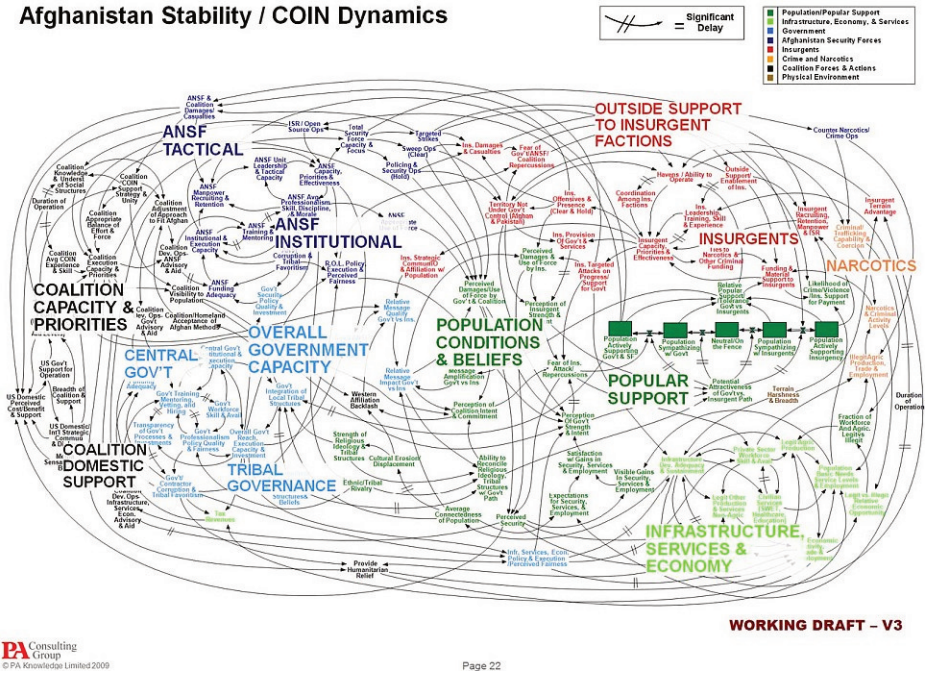


Figure 2. Diagram of Afghanistan conflict. (Mail Foreign Service, 2010)

Just how one can come to understand the diagram is a good question. Looking at it for a long, long time is one approach; conducting a simulation is far better. Complex human systems are almost impossible to grasp in the abstract. Only by interacting with a model (or the real thing) can a person come to the required level of familiarity with the way the system operates. Games are models of human systems and have been used to simulate military encounters for more than two centuries. As strategic thinking adapted into the untidy mess of modern COIN operations, similarly complex game models evolved. COIN operation simulations have

a long history (Combs, 1973) and recently have included video games (McAlinden et al. 2008), agent-based models (Kott & Skarin, 2010), complex network analysis (Giabbanelli, 2014), and genetic algorithms (Lafond & DuCharme, 2011).

Digital simulations are powerful, but face-to-face paper exercises remain an important part of the military simulation environment. Such tabletop simulations are also most appropriate for using with less-experienced groups and in classrooms. In the past decade, the game company GMT has published a series of tabletop simulations of COIN situations. The basic mechanics were designed by CIA analyst Volko Ruhnke (Albert, 2014). Reception within the community of military simulation enthusiasts suggests that Ruhnke's COIN system offers an unflatteringly realistic portrait of the dynamics of modern (and older) civil wars (Albert, 2014; see also discussions about COIN games at ConSimWorld, 2018).

An overview of the COIN system follows. It is based on the author's direct experience with several games in the series, all published by GMT Games, including *Andean Abyss* (Colombia), *Fire in the Lake* (Vietnam) (Herman & Ruhnke, 2018[2014]), *A Distant Plain* (Afghanistan) (Ruhnke & Train, (2018[2013]), *Liberty or Death* (American Revolution) (Buchanan, 2017[2016]), and *Falling Sky* (Roman Gaul) (Ruhnke & Ruhnke, 2016). All of these systems were published in the period 2012-2018. This overview describes the typical features of COIN games, but it should be noted that each game has its own unique features, and some may or may not include one or more of the typical features described here.

A COIN game is played by four people in a space of about 6 hours. One player is the government of the region in question, and a second player is the primary opponent of the government. A third player is an unreliable ally of the government, while the fourth is a wild card of some kind, an armed faction with no interest in politics or government but who stands to benefit from the chaos. In *Andean Abyss*, the government player is the Colombian government, the opposition player is the communist revolutionary movement FARC, the government-ally player is the AUC (the far-right paramilitary), and the wildcard player represents Colombia's large and well-armed drug cartels. In the Afghanistan and Vietnam versions, the unreliable ally of the local government is the United States.

This four-player alignment works in so many different situations because of the underlying nature of civil conflict. There are two opposing factions at war: One in power, and another of opposite political alignment who has exited the normal political process to take up arms. This is the standard Left-Right spectrum, with one side in charge and the other fighting from the underground. The third player emerges as a result of the violence. Once the government is at war with an enemy faction, it becomes criticized by others who desire a more effective, tougher approach to the revolutionaries. Sometimes those others are external, as in Vietnam; sometimes they are internal, as in Colombia. The third player takes up arms in order to "help," but in fact has its own agenda, distinct from that of the government. The fourth player, finally, arises to profit from the chaos. This player wants none of the others to succeed in their goals but prefers ongoing war. In some cases, this is a tribal-warlord faction, in others it is a crime faction, and it can also be a mixture of both.

Each faction has its own resources and victory conditions. They are assigned standard colors from military simulation practice, where us versus them is depicted as blue versus red, with yellow and green as other parties.

Information for American Abyss Players

Faction	Color	Resources	Goal
Government	Blue	Tax revenue / military	Control territory
Rebels	Red	Donations / volunteers	Control territory; avoid destruction
Rogue	Yellow	Internal: Donations / volunteers External: Massive foreign funding	Destroy Red; Minimize losses / commitment
Chaos	Green	Crime profits	Make money; avoid destruction

The asymmetry in resources and objectives is what produces the interminable chaos of these conflicts. The most likely alliances would seem to be Blue and Yellow against Red and Green. However, the conflict refuses to stay within these pretty boundaries. Blue can tolerate the existence of Red, so long as it (Blue) is allowed to control a great deal of territory. Red, meanwhile, views its own continued existence as a success. Therefore, Red and Blue could unite to carve up the country. This is anathema to Yellow,

of course, whose raison d'être is the destruction of the Red Menace. Not only that, but in cases where Yellow is a vastly wealthy external power (e.g., the United States), Blue has an incentive to siphon resources from Yellow as often as possible.

Meanwhile, the Red/Green pseudo-alliance breaks down because Green wants chaos alone. Green opposes any Red effort to pacify its areas of the country. Moreover, Green may gain from corrupt elements of Blue; and the government may benefit from turning a blind eye to Green's activities.

In short, alliances are possible all across the strategic space. None of them are stable. Instead, whenever one faction seems close to its goals, the other three combine against it. Peaceful balance of power among many poles was achieved in Europe from 1648 to 1914, more or less, and we are learning how amazing that achievement was. In most multi-polar conflicts, war continues until people finally and definitively lay down their arms. It can take a very long time.

In COIN games, action is driven by a unique card-based system of initiative. A large deck of cards sits to the side. Each turn, one card is drawn. That card gives the primary initiative in the turn to one player, and a secondary initiative to another. This means that the first player, player A, gets a full turn. Then, depending on how A conducted his turn, B gets a limited turn. Either or both players may pass, giving the initiative to others. If they do not pass, however, but take actions, they become ineligible for the next card. In practice this system leads to extreme uncertainty about one's scope of action. The deck is built so that every player has access to the same amount of action of the course of the game, but no one has any idea of how active anyone will be in the short to medium term. It becomes a game of seizing opportunity: If an opportunity to strike hard arises, take it now. Do not plan for the future, because the situation will have changed radically by the time you get to move again.

The dynamics of game play are chaotic and it is immensely hard to pursue any kind of long-run vision. It is hard to shape the game. Reversals of fortune are common. Golden opportunities seem to randomly fall in your lap. Investments in long-run capabilities that seem extremely attractive are often far more expensive than is apparent. It may seem like a good

idea to take a break from fighting to train your troops or develop better intel capabilities. But the card actions used to build these capabilities are necessarily not being used to seize whatever opportunities there may be to actually make a move on the map. In a situation where opportunities to affect the on-the-ground situation are rare, failing to take one of these opportunities can be fatal. Thus, players necessarily focus each turn on moving toward their victory conditions in some way. They know full well that by the time they move again, everything they have been doing may have been destroyed by someone else. Yet there is nothing else to do but try to move something forward into the chaos.

COIN games are understood to be among the most frustrating games to play. It is apt. Civil conflicts in the real world are maddeningly frustrating to anyone involved in them. It seems that no one can actually do anything at all, except keep playing.

COIN-ING AMERICA

The political landscape in the contemporary United States is well-suited to a COIN interpretation. The population is bitterly divided on the left-right spectrum. An effort to de-arm the public would surely result in some level of violence, given the Constitutional right to keep and bear arms per the 2nd Amendment to the U.S. constitution. Among several groups, there is sentiment that violent street action may be necessary in order to disrupt harmful narratives and silence harmful actors. Meanwhile, criminal organizations freely use violence in turf battles. As of this writing, thankfully, none of this has evolved to the level of a shooting war. The faction alignments, however, are in place and as I noted above, speculation has been growing that the time for violent conflict may be coming.

What if? If such a thing were to come to pass, how would it play out? One can imagine several scenarios, but I will discuss two in particular. These are only scenarios, not predictions, and neither is favored by the author. What follows is an effort to describe how a future COIN dynamic might evolve given the factions currently present in the United States.

Scenario 1: Leftist rebellion against a rightist government

In this scenario, a right-wing government in Washington, DC is viewed with great distrust by people on the left. For whatever reason, the federal government has lost credibility in the largely urban areas on the coasts of the country. Self-proclaimed "anti-fascist" organizations in these areas have combined into fighting units of variable quality and commitment. Their goal is to "save the country" by overthrowing the DC government. The government has responded by sending U.S. military forces into these areas on pacification operations. Viewing these efforts as half-hearted, rural anti-socialist organizations have combined into vigilante guerilla bands that impose their own justice on rebel areas and people. Meanwhile, criminal organizations have expanded without limit, freely using violence, intimidation, and extortion to protect and extend their networks of drug and human trafficking. The four factions are Blue: Government; Red: Anti-fascists; Yellow: Anti-socialists; and Green: Crime lords.

Scenario 2: Rightist rebellion against a leftist government

In this scenario, a left-wing government in Washington, DC is viewed with great distrust by people on the right. For whatever reason, the federal government has lost credibility in the largely rural areas in the middle of the country. Self-proclaimed "anti-socialist" organizations in these areas have combined into fighting units of variable quality and commitment. Their goal is to "save the country" by overthrowing the DC government. The government has responded by sending U.S. military forces into these areas on pacification operations. Viewing these efforts as half-hearted, urban anti-fascist organizations have combined into vigilante guerilla bands that impose their own justice on rebel areas and people. Meanwhile, criminal organizations have expanded without limit, freely using violence, intimidation, and extortion to protect and extend their networks of drug and human trafficking. The four factions are Blue: Government; Red: Anti-socialists; Yellow: Anti-fascists; and Green: Crime lords.

In other words, given current alignments and resources it is not difficult at all to imagine and describe a four-pole civil conflict in the United States, in

the near- to medium-term future, that would be plausible *regardless* of the ideological alignment of the different factions.

A conflict along these lines may or may not be in America's future, but the COIN system lets us play out, now, what it would be like. Engaging with this kind of simulation is an important and valuable activity for all citizens, of every ideological stripe. The COIN system replaces wild fantasies about warfare with a carefully crafted simulation. The simulation comes much closer to reality, and, as we will see, it is not always a happy thing.

2040: AMERICAN ABYSS

In this section, I introduce two games that use COIN game mechanics to model a civil war in the United States. The first, *American Abyss*, is a simplified classroom-ready simulation based on the fundamentals of COIN conflicts. The second game is a complex modification of Volko Ruhnke's *Andean Abyss*. Here we will discuss the games and highlight their key features and affordances. Materials for playing the games, and everything needed for the student including map, rules, and instructor materials, can be found in Appendix 1 and 2.

American Abyss: Student Edition

COIN situations are complicated, and so are the published COIN simulations. Not everyone has time to learn a highly complex game. Fortunately, the basic lessons can be taught with a simplified version that plays quickly. To this end, I developed a vastly simplified COIN game and set in a futuristic American context. This is *American Abyss: Student Edition* (AASE) and is available in Appendix 1.

AASE is a complete packet suitable for use as a classroom exercise at the middle-school level and above. The total time requirement is 30-60 minutes. The rules of the simplified version are very short, and most of them are printed on the map that comes along with the student edition. In other words, students can look at the rules, right on the board, while they play. There are far fewer pieces, and the map is simply a U.S. map

with seven regions: Northeast, Southeast, Midwest, North Central, South Central, Northwest, and Southwest.

Despite the simplicity, AASE captures the essential dynamics of a COIN situation. The four factions are there: Blue, Red, Yellow, and Green. They each have different pieces and different victory conditions. Blue needs to control regions; Red needs to control some regions but also have a lot of pieces; Yellow needs to destroy Red; and Green needs to have pieces on the board and make a lot of money. The shifting-alliance nature of COIN dynamics is captured by these simple mechanics.

In order to explain to students what these factions are, sex- and ethnic-neutral characters have been invented for them to roleplay. President Blue is President of the United States. Colonel Red is the leader of the rebels. Agent Yellow is a former official who now runs a private anti-red vigilante army. Dr. Green, who retired from the pharmaceuticals industry, is the head of the crime lords. A handout explains who these people are, how they are motivated, how they play the game, and how they win.

AASE requires 27 differently-colored pieces: 12 blue, 9 red, 6 yellow, and 6 green. Any kind of small, properly-colored token will work. They can be taken from other games or purchased at a hobby store. AASE also includes a rules document for teachers (and students, as desired), and also a Teacher's Guide.

In playtests with college freshmen and sophomores, students rather gleefully adopted the personae of President Blue, Colonel Red, Agent Yellow, and Dr. Green.[1] The first games took only a few minutes, because the players did not yet understand how their actions would contribute to the victory of others. For example, a Blue player attacking Red troops may not realize that this aids Yellow's victory condition, which is to have more troops than Red does. In this situation, Blue's success against Red might accidentally give Yellow the victory. As players became more aware of the complex interactions of resources and goals, they began to pay more attention to the victory conditions of the other players. Once this had happened, game length extended considerably and the students began to express a level of puzzled frustration that it was so hard for anyone to win.

1. AASE was playtested in August 2018 with 80 college students in Introduction to Games, course MSCH-C210 at Indiana University.

This realization then led into useful post-game discussions of why the game slowed down, why it was hard to win, why it seemed to go on a much longer time. These discussions supported the ultimate take-away for the students, which was that four-player civil wars can go on for a long time with no apparent winner.

2040: American Abyss

For those willing to embrace the full complexity of contemporary internal conflict, a complete simulation of an American Civil War was developed using the materials of Volko Ruhnke's *Andean Abyss.* To play this game, *2040: American Abyss* (hereafter AA), players must have the following:

- The rules in Appendix 2
- A copy of *Andean Abyss*, by Volko Ruhnke, available from GMT Games
- A game map of the US, which is Figure 3 below

Rules

The rules document is three pages. It explains how the equipment in *Andean Abyss* is to be used when conducting the U.S.-based scenario.

The rules also provide a setup for the two scenarios above (i.e., the leftist rebellion against the rightist government and the rightist rebellion against the leftist government). In the first scenario, the Red pieces are largely on the coasts and in urban areas, while Yellow is in the countryside. In the second, the Red pieces are largely in the countryside while the Yellow pieces are in the coasts and in the cities.

The two scenarios play quite differently. Scenario 1 is often shorter than Scenario 2. It depicts a left-wing revolt against a right-wing government. In this scenario, the rebel bases are in large cities. This is a most dangerous place to be, given the typical mechanics of a COIN situation. Cities are where the government is strong. Governments can easily bring military and economic power to bear in the cities. The cities are connected by lines of transit; the cities are where large numbers of troops and police

can be raised. Getting these troops out to the countryside, and pacifying those rural areas, is typically the problem for the government faction. But in this scenario, the rebels are near at hand: Sitting ducks in Los Angeles, San Francisco, and New York. In playtesting, the government player was generally able to amass troops and police in those areas and snuff out the rebellion there. It was difficult for the Red player to recover. The government tends to win Scenario 1 fairly quickly. Scenario 2 is truly an abyss, a conflict that continues for a long time.

Andean Abyss

The game *Andean Abyss* provides the core rules and all the equipment for the game.

"Core rules" describes the basic mechanics of the COIN system. The *Andean Abyss* rulebook describes the factions and the pieces, and explains how the card mechanics work. The game also includes player aids for the four factions and sets the victory conditions for them. Readers are warned that the COIN system is not easy to learn. Its realism comes at the price of complexity. The complexity is necessary, though, because the underlying political-military dynamics are complex.

The equipment includes wooden playing pieces and a large deck of action cards. Each faction's pieces are correspondingly colored: Blue for Government, Red for the Rebels, Yellow for the Vigilantes, and Green for the Crime lords.

Using the cards requires extra attention. This card deck was designed for a game about Colombia in the 1990s. Therefore, every card makes reference to events and personalities of that time and place.[2] This "flavor text" is irrelevant for a game about an American civil war in 2040 and has to be ignored. (In playtests it *has* been interesting to note the parallels between Colombian events and those that could happen in the United States.) Each card has mechanics, however, that can be implemented largely as written, with a few translations. For example, a card may say the government may call an airstrike on any "FARC" base. The faction FARC in Colombia in the

2. In future development, a card deck specifically for this game may be developed. If so, it will be made available at the game's web site, https://edwardcastronova.com/portfolio/american-abyss/.

1990s was the rebel faction against the government. It is the Red faction. Once this is understood, the card can be quickly interpreted as saying that the Blue faction may call an airstrike on any Red base.

In fact, every reference to Colombia in the mechanics of *Andean Abyss* has a simple analog for a U.S. implementation. The *American Abyss* rules specify what these analogs are. With these translations, all of the equipment and cards in *Andean Abyss* can be used for this simulation.

Figure 3. Game map for 2040: American Abyss

Map

Figure 3 shows a map of the United States that has been overlaid with information relevant to a COIN-style game. The country is broken up into regions that are joined by important lines of communication, in our case the Interstate Highway system, with national favorites like I-95 in the east, "the 5 freeway" in the west, and I-80 cutting across the whole country. The map indicates terrain types—forest, mountain, city, etc.—all of which affect movement of forces and execution of operations. Mexico and Canada may come into play, and so there is some game information there as well.

Numbers on the map indicate such things as population size and economic value, while different boxes indicate who controls an area, whose turn it is, and so forth. A numerical track around the edge of the map is used to record how many resources the different factions have, as well as how close they are to their victory conditions.

Concrete steps: How to actually play

- First, obtain a copy of *Andean Abyss* and play it several times until comfortable with the COIN system.
- Print Figure 3 at the size 22" x 34". A high-resolution image is available at https://edwardcastronova.com/portfolio/american-abyss/
- Read the *2040: American Abyss* rules in appendix 2 to learn how the *Andean Abyss* pieces are to be used in a future U.S. setting.
- Set up the chosen scenario, invite three other players, and begin.

All told, the game may take as long as 6 hours to complete. Most of the lessons to be learned, however, will come much more swiftly. Within the first hour it will become apparent what sort of a war this would be.

CONCLUSION

Playing through U.S.-future civil war scenarios with students and play-testers led to two revelations of note:

First, given the factional alignments of the contemporary United States, one can easily surmise that any armed civil conflict here would involve more than two factions. Many types of political groups have weapons and seem willing to use them if conditions get bad enough. It seems likely that any civil conflict would expose multiple poles of armed power, left/right, governmental/non-governmental, domestic/foreign, criminal/lawful. This would not be a nice little war; it would be a dumpster fire.

Secondly, it would seem that some scenarios would be shorter than others. An uprising based in coastal urban areas would find itself directly in the crosshairs of the modern state. Massive state power can be projected

into urban areas, whether it be military, psychological, police, or economic power. Blue would have little difficulty responding with tremendous force, should a Red rebellion erupt in urban areas. The conflict would end soon. Now, the unique geographic left-right breakdown in America suggests that any left uprising would probably be an urban one. If so, then the power-politics of this simulation suggest that a left uprising, though possibly bloody, would not last long.

2040: American Abyss was designed with one purpose in mind, and that is to allow players to enact such scenarios within a realistic simulation of the civil war that may come. It is meant to be a tool for exploration. If players pursue more possibilities—if they change the setup, create new mechanics, add different factions, and/or alter the victory conditions—then the game has served its purpose.

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APPENDIX 1: AMERICAN ABYSS: STUDENT EDITION

A classroom simulation of the next U.S. civil war

This packet provides a classroom role-playing exercise that lets students explore this question: If a civil war broke out in the United States in the future, what would it be like? The basic lesson of the exercise is that civil wars in the modern era are not like the American Civil War in the 19th century. Modern civil wars are nasty conflicts with multiple armed forces all fighting each other. Nobody wins; the people lose. Students will directly experience how such multi-polar conflict leads to stalemates and endless violence.

The exercise is suitable for middle-school students or above. It is based on a much more complex and realistic simulation that is available from the author on request. Note: The simulation and this exercise are politically neutral. The factions are fictional and have no relation to current political parties.

1. What you need

To do this exercise, you need:

- A map of the US, broken into seven regions (Northeast, Southeast, Midwest, North Central, South Central, Northwest, and Southwest). A suitable map is included below.
- Four sets of colored pawns or playing pieces, Blue, Red, Yellow, and Green (other colors can be substituted):
- Blue: 12 pieces
- Red: 9 pieces
- Yellow: 6 pieces
- Green: 6 pieces
- Rules
- A six-sided die

- This information packet

2. Running the exercise

Divide the class into groups of at least four students (the exercise will not work with fewer than four students in a group). Each group of four should receive one game set (map, pieces, die, and rules).

In each group, assign one student to each of these roles, and give them the handout explaining their role.

- President Blue. Blue is the President of America, trying to end the civil war.
- Colonel Red. Red is the leader of the rebels, who want to take over the government.
- Agent Yellow. Yellow leads a private outlaw army that is the bitter ideological enemy of the Reds. The Yellows hate the Reds even more than the government does.
- Dr. Green. Green is a former pharmacist who now runs the biggest drug cartel in America. Green wants to expand the criminal empire and make money.

Once the students have looked over their roles, tell them that fighting has broken out among these factions and their job is to make their faction win. Give out the rule sheet and walk through the rules.

Next, let the students play the game for a fixed period, which should be at least 15 minutes and no more than 30 minutes. Tell the students to start over each time someone wins. After a few quick games, the students will begin to see what they have to do to stop others from winning. Once the players understand this, the game will settle into a violent back-and-forth. Have the students keep playing until the time limit is up.

3. After the exercise

Select one or two groups and ask them to tell the class what happened in

their game. It will be a story of people attacking each other back and forth, with shifting alliances and enemies. Then have the class work through these discussion questions.

- Which side fought the most? Which side lost the most? Was any of the groups better than the others?
- When a group became strong, did that last a long time? (No)
- Why was it hard for any player to keep his group on top? (Because the others ganged up on the leader)
- Is it possible in this game for anyone to stop the war by eliminating all enemies? (No)
- Would a situation like this ever lead to a single, clear winner? (No) Why not?
- If this situation happened, what would people have to do in order to end the war? (Put down their guns and negotiate)
- It is impossible for any group to win this kind of war. Does anyone *lose*? (Yes, the civilians)
- What are some things people could do today to help prevent a civil war like this?

4. Additional materials

The rest of the packet includes the various handouts.

- Roles (1 page each)
- President Blue
- Colonel Red
- Agent Yellow
- Dr. Green
- Rules of the game (2 pages)
- Game map (1 page)

5. Acknowledgments

American Abyss: Student Edition is based on *2040: American* Abyss, which a modification of the game *Andean Abyss*, designed by Volko Ruhnke and published by GMT Games.

Design: Edward Castronova

Art: Edward Castronova

Playtesting: Jeff Lewis, Kevin Klemme, Ben Klemme, Rick Watson, Fall 2018 students in Indiana University's C210 Introduction to Games.

PRESIDENT BLUE

You are President Blue, the President of the United States in the year 2040. You were elected recently but the election was very close. A lot of people don't like your government. A former Army officer named Colonel Red has started a rebellion and has put together a private army. Now these Reds are trying to take over the whole country by force. You have to stop this Red rebellion.

Other things are going wrong too. A former secret agent, Agent Yellow, has also made a private army, but only because Yellow really hates the Reds. Agent Yellow thinks you are too soft on the Reds, so the Yellow army is trying to hunt the Reds down themselves. The Yellow team is on your side for fighting the Reds, but they are crazy and super violent, and they may attack you if they feel like it. If the Yellows get too strong, they might even take over. You have to beat the Reds without letting the Yellows get too strong.

Finally, there is the crime problem. Dr. Green is a big-time drug lord. Green is in charge of an illegal mafia that smuggles drugs and all kinds of bad things into America from other countries. The Green Mafia makes tons of money from all this crime. Since you are the government, it's your job to go after the Greens and fight their dirty operation.

Can you save the government and keep control of America?

***

President Blue

Pieces: 12 blue Troops

Set up: 2 Troops each in Northeast, Southeast, Northwest, and Southwest

How to win: If you control at least 4 spaces at any time, the game ends and you win!

You control a space if you have more troops than all other groups *combined*.

COLONEL RED

You are Colonel Red, leader of the Rebels. You were in the Army for a long time, but you started to really hate the government and the way everything was going in Washington DC. The final straw was when President Blue was elected. You think Blue is a dictator, so you have launched an armed rebellion to save our democracy. Lots of people have joined your side, so now you a big rebel army under your command. With this army, you have gotten into gun battles with the government and have even started to take over different parts of the country. Your goal is to get the corrupt President Blue out of the White House and take control yourself.

You have started a civil war, but some other things have happened that you did not expect. Some of the people who are on Blue's side are not following the law either. Agent Yellow has raised a private army too, just like yours. But the goal of Yellow's army is not to beat the government but to defeat *you*. The Yellows are kind of crazy and extremely violent. So, while you are trying to beat the government, you also have to keep the Yellow army from beating you by itself.

While all this is going on, the drug lord Dr. Green has started to expand a big criminal mafia across the whole country. This criminal element goes against everything you stand for. There's no point in winning a revolution if the country becomes just a big crime empire. So, you also have to fight against the crime.

Can you save America's democracy?

***

Colonel Red

Pieces: 9 red Troops

Set up: 2 Troops each in Northwest and Southeast

How to win: Add the troops you have on the map, plus the spaces you control. If this number is greater than 8 at any time, the game ends and you win!

You control a space if you have more troops than all other groups *combined*.

AGENT YELLOW

You are Agent Yellow. You used to work in the government as a secret agent. But you got mad because President Blue was not doing enough to stop the Reds. President Blue spent a long time trying to work things out with the Reds, but you think he should have been throwing them all in jail! You think Colonel Red and all those people are just plain evil. They want to become dictators and destroy American democracy! They must never be allowed to take over the government!

So you decided to have your own private war against the Reds. You put together an army of fighters who hate the Reds as much as you do. Then you started attacking the Reds, without any orders from the top. When the top people heard about that, President Blue tried to have you arrested! So, you ran off into the woods. You will keep fighting the Reds, and the government if necessary, until this war is won.

While all this is going on, you have another worry. Dr. Green, the crime lord, has been expanding a criminal mafia across the country. That is no good either. Those people smuggle all kinds of drugs and bad things into the country and make a huge profit. They have to be stopped too. What good

would it be to defeat the Reds, if the whole country just becomes a big drug smuggling empire?

Can you stop the Reds and save American democracy?

***

Agent Yellow

Pieces: 6 yellow Troops

Set up: 2 Troops in Northeast

How to win: If you have more troops on the board than the Reds do, at any time, the game ends and you win!

DR. GREEN

You are Dr. Green, a crime lord. You are a brilliant scientist who used to work for a drug company, inventing new kinds of drugs for sick people. Then you realized that you could make a lot more money by inventing party drugs. You set up drug factories in other countries and started to smuggle the party drugs into the United States.

You have made so much money doing this, and you also became the biggest crime lord in the country. When Dr. Green tells people what to do, they do it or they "disappear." As a crime lord, you have your own army of thieves, gangs, and smugglers to fight anyone who becomes an enemy.

This rebellion that Colonel Red has started is a great profit opportunity for you. With the government so busy fighting the Reds (and the Yellows, who are even more crazy), you can expand your crime empire all over the country. To you and your Green Mafia, this chaos means only one thing: Money, money, money!

The problem is how to avoid being noticed. All the other people in this war – President Blue, Colonel Red, and Agent Yellow – are against crime. Any of them could attack you at any time.

Can you expand your criminal empire and make millions of dollars?

***

Dr. Green

Pieces: 6 green Troops

Set up: 2 Troops in Southwest

How to win: If you have $15 million AND troops in at least four different spaces, the game ends and you win!

AMERICAN ABYSS: STUDENT EDITION

Rules

American Abyss is a strategy game about a possible future civil war in the US. There are four sides: President Blue, Colonel Red, Agent Yellow, and Dr. Green.

1. Components

To play this game you need:

- A game map. The map shows the continental United States divided into seven different regions: Northeast, Southeast, Midwest, North Central, South Central, Northwest, and Southwest
- Pieces. Each piece represents one Troop. There are 12 blue, 9 red, 6 yellow, and 6 green pieces.
- A six-sided die
- These rules

2. Setup

Lay out the map on a table. Each player takes the pieces in their color (blue, red, yellow, green). Put starting pieces on the map:

- Blue: Two troops each in Northeast, Southeast, Northwest, and Southwest
- Red: Two troops each in Southeast and Northwest
- Yellow: Two troops in Northeast
- Green: Two troops in Southwest

Choose a random player to go first. You are now ready to play.

3. How to play

The game goes around the table clockwise, starting with the first player.

When it is your turn, do the following things in this order. They are all voluntary, you don't have to do them if you don't want to.

- Recruit.
- Take a new troop and put it on the map.
- It can go anywhere you already have Troops.
- If you don't have any Troops on the map, you can put it anywhere.
- Move.
- You can move one group of your Troops from their current space to one adjacent space.
- If you are President Blue (the government), you can move two spaces. It can be one group of Troops going two spaces, or two groups each going one space.
- When leaving a space, the government must always leave one Troop behind as a garrison.
- Fight.

- Select one space where you have Troops and there are also Troops of another faction.
- If there are several enemies there, choose which one to attack.
- Roll the die.
- If the number is **equal to or less than** the number of Troops you have in the space, you win. One enemy Troop is destroyed (it must belong to the enemy you picked). The rest of that enemy's Troops move to an adjacent space. You choose where they go.
- When the Government wins (President Blue), it destroys two Troops.
- If the number rolled is **more than** your total Troops in the space, you lose. One of your Troops is destroyed. You move the rest of your Troops to an adjacent space. You choose where.
- Destroyed Troops go back to the player's stock. They can come back into play.
- Profit (Green only)
- If you are the Green player, check your profit for this turn.
- Your profit is $1 million for each Troop you have on the board.
- Keep track of your total profits on a separate sheet of paper.

When you have finished your turn, play goes to the next player on your left.

4. Ending the game

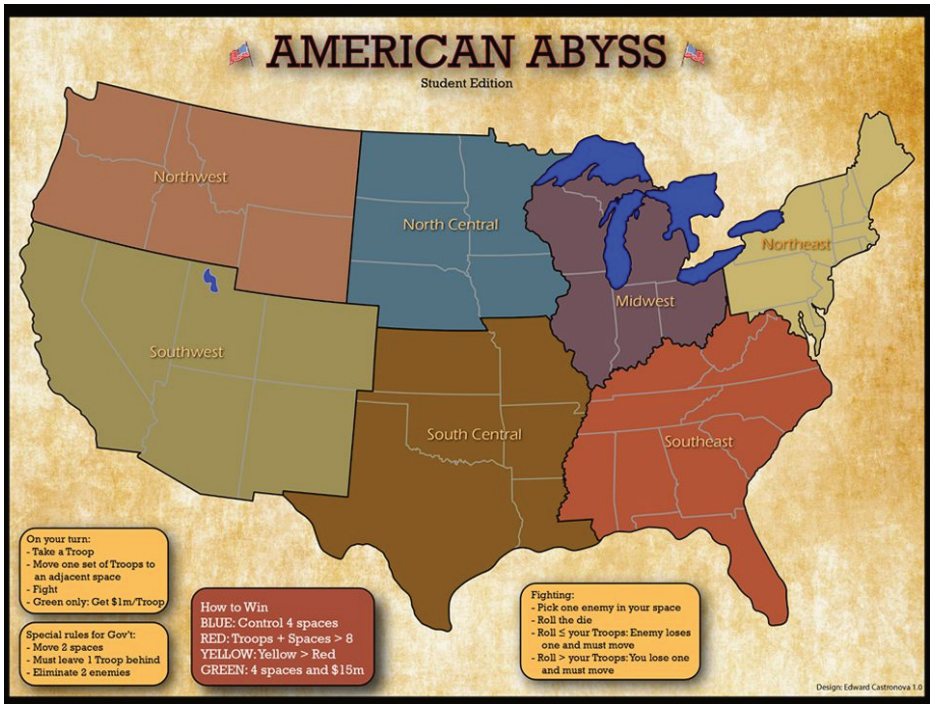
If any player meets their victory condition, the game ends and that player wins. Note: A player controls a space when they have *more* Troops there than all other players *combined*.

- BLUE: If Blue controls at least 4 spaces, Blue wins
- RED: Add the number of Red Troops on the board plus the number of Red-controlled spaces. If this number is greater than 8, Red wins.
- YELLOW: If Yellow has more Troops than Red, Yellow wins.
- GREEN: If Green has at least $15 million in profit and Troops in at least 4

different spaces, Green wins.

The game continues until one player meets their victory condition.

The players can also decide beforehand how long they want to play (usually 10 – 30 minutes). In this case, the game ends when the time is up. In this case, the winner is the player who is closest to their victory condition.



APPENDIX 2: RULES FOR 2040: AMERICAN ABYSS

Simulating the next U.S. civil war

American Abyss is a four-faction simulation of a modern American civil war. The main struggle is between the government faction (Blue) and the insurgent or rebel faction (Red). Then there is a paramilitary faction (Yellow), which fights the rebels but is outside the law. Finally, there are crime lords (Green), who exploit the chaos to expand their criminal empires. Each faction is an enemy to all the others. Red wants to take

control. Blue wants to retain control and stop the fighting. Yellow wants to defeat Red while building its own private army. Green wants to build a crime network. It is a war of all against all.

The simulation does not depend on right-left politics; it works the same regardless of who is in charge. In one scenario, the government could be Rightist, the rebels Leftist, and the paramilitaries ultra-Rightists. In another, the government could be on the Left, the rebels on the Right, and the paramilitaries on the far Left. The players can decide beforehand whether they are simulating a right-wing rebellion against a left-wing government, or vice versa, or none of the above.

The design goal for *American Abyss* was to explore what a modern American civil war would be like (basically, a dumpster fire). The game is a mod of *Andean Abyss*, designed by Volko Ruhnke and published by GMT Games.

How to Play

To play the game, you need three things.

- A copy of *Andean Abyss* by GMT Games
- The game map, american_abyss.pdf
- These rules

American Abyss uses the rules, cards, and pieces of *Andean Abyss* but puts the on a map of the continental United States. Simply print out the map, set up the game according to the scenario below, and start playing using the ordinary rules of *Andean Abyss*.

The remainder of these rules handles a few translations and exceptions that will come up.

Factions

In this mod, the four factions are as follows:

- Blue: The Government, which is trying to keep control.

- Red: Rebels, who are trying to overthrow the government.
- Yellow: Paramilitaries, violent extremists who hate the Reds.
- Green: Crime Lords, who are using the chaos to build their criminal empire.

Setup

After choosing sides, players should choose one of two scenarios. The Anti-Socialist Scenario depicts a right-wing rebellion against a left-wing government. The Anti-Fascist Scenario depicts a left-wing rebellion against a right-wing government. After choosing a scenario, set up the board as indicated. Then set up the deck exactly as in *Andean Abyss* and begin play.

ANTI-SOCIALIST SCENARIO

Resources: Blue 40, all others 10. Aid 9. Total Support: 50. Opposition Bases: 20.

Active Support: New England and Cascadia, and all cities except Phoenix.

Active Opposition: Great Lakes, Appalachia, South, Texas, and Big Sky. Passive Opposition: Florida.

Blue: 2 Police in Washington, 1 Police in every other city. 3 Troops each in Washington, Chicago, Los Angeles, and Atlantic (12 total). Base in Atlantic.

Red: Bases in Great Lakes, Big Sky, Appalachia, South, Texas, Florida (6 total). 2 Guerillas each in Texas, South, Appalachia (6 total). 1 Guerilla each in Big Sky, Great Lakes, Florida, Cascadia, New England, and Atlantic (6 total, 12 overall).

Yellow: Base in New England. 2 Guerillas in New England. 1 Guerilla each in Atlantic, Cascadia, Midwest, and Great Lakes (4 total, 6 overall).

Green: Bases in Midwest, Appalachia, South, Texas, Florida, and Phoenix (6 total). 1 Guerilla each in Texas and Florida (2 total).

ANTI-FASCIST SCENARIO

Resources: Blue 40, all others 10. Aid 9. Total Support: 46. Opposition Bases: 20.

Active Support: Atlantic, Great Lakes, Midwest, Appalachia, South, Florida, and Texas. Washington, Jacksonville, Dallas, Houston, San Antonio, Chicago

Active Opposition: San Francisco, New England, and Cascadia. Passive opposition: Seattle and New York.

Blue: 2 Police in Washington, 1 Police in every other city. 3 Troops each in Washington, Chicago, Los Angeles, and Atlantic (12 total). Base in Atlantic.

Red: Bases in San Francisco, Seattle, New York, Los Angeles, Cascadia, and New England (6 total). 2 Guerillas each in Cascadia, New England, San Francisco, Los Angeles (8 total). 1 Guerilla each in Seattle, Los Angeles, New York, Atlantic (4 total, 12 overall).

Yellow: Base in South. 2 Guerillas in South. 1 Guerilla each in Midwest, Great Lakes, Appalachia, and Texas (4 total, 6 overall).

Green: Bases in Midwest, Appalachia, South, Texas, Florida, and Phoenix (6 total). 1 Guerilla each in Texas and Florida (2 total).

Terms

Clarification of several terms in the *Andean Abyss* rules and player aid cards.

- Government: Refers to the Blue faction.
- FARC: Refers to the Red faction.
- AUC: Refers to the Yellow faction.
- Cartels: Refers to the Green faction.
- El Presidente: Ignore all presidential election mechanics.
- Pipeline: Refers to a Line of Communication of value 3 or more.
- Bogota refers to New York.
- Aid: The Aid mechanic is unchanged. However, Aid is interpreted here as the benefit of increased legal economic activity that happens when

crime is suppressed.

Cards

The cards for *Andean Abyss* refer to events in Colombia and naturally make no sense in an American context. Therefore players should simply ignore the flavor text on the cards. Each card's mechanics, however, should be followed exactly. All the card mechanics are directly applicable to the U.S. map. For example, when a card says "Government conducts free Air Strike in one Forest space," the Blue player conducts a free air strike in a Forest space on the American map: Cascadia, Great Lakes, or South. Players should use their collective common sense to interpret and apply the card mechanics as written. If common sense fails to resolve a question, determine the outcome randomly.

The following cards have additional notes:

- Amazonia. "0 Population Forests" = any 0 Population region in the United States (not Mexico or Canada). Guainia = Big Sky, Vaupes = Prairie, Amazonas = High Plains
- Cano Limon-Covenas. Pipeline = any LoC with value of 3 or more.
- Darien. Choco = Texas. Panama = Mexico. Mexico is a 0-Population Mountain area with room for 2 bases. Sweep does not activate guerillas there.
- Ejercito de Liberacion Nacional. Antioquia = Appalachia
- Hugo Chavez. Venezuela = Canada. Canada is a 0-population Grassland with room for 2 bases. A faction can have no more than 2 pieces there. Canada shares borders with Great Lakes and New England (only).
- NSPD-18. Interpret the "US" here as the European Union. When the government suppresses crime, the legal economy grows, pleasing world markets.
- Occidental and Ecopetrol. Pipeline = any LoC with value of 3 or more.
- Oil Spill. Pipeline = any LoC with value of 3 or more.
- Pinto and del Rosario. Cucuta = Chicago

- Pipeline Repairs. Pipeline = any LoC with value of 3 or more.
- Sucumbios. Ecuador = Canada; see above. (Canada represents both Ecuador and Venezuela.)
- Union Sindical Obrera. Pipeline = any LoC with value of 3 or more. Bogota = New York.

Victory Conditions

The victory conditions are the same as in *Andean Abyss*.

- Blue: Support > 60
- Red: Opposition Bases > 25
- Yellow: Yellow Bases – Red Bases > 0
- Green: Bases > 10 and Resources > 40

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When the Mind Moves Freely, the Body Follows

Exergame Design, Evaluation, and the Curious Case of Pokémon GO

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ABSTRACT

Exergames, video games that mediate physical exercise, have been used with demonstrable success to improve physical fitness. However, the health impact that exergames can achieve is not restricted to increasing the amount of players' physical activity. These games have been used in other aspects of healthcare, such as cognitive training and mood-improvement, and may reduce the burden of treatment experienced by patients. To measure such parameters, researchers require different kinds of methodologies that can assess the subjective perceptions of patients *and* take into account the social relatedness, autonomy, and sense of competence offered by good exergames. This article provides an overview of the health benefits of exergames that have been measured to date, the methods by which the data on these benefits has been obtained, and the design principles that maximize the self-motivation that serious games can evoke from their players. We provide an analysis on the factors that propelled *Pokémon GO* (Niantic, 2016a) into becoming one of the most successful exergames in recent memory and the apparent decline of interest towards the game. By assessing the lessons learned from *Pokémon*

GO, as an example of successful exergame design, and by developing innovative and comprehensive methodologies for evaluating effects, this paper suggests how exergames more broadly may better serve the holistic health benefits of players at a large scale.

INTRODUCTION

Exergames, defined as video games that mediate physical exercise (Oh & Yang, 2010), are one of the earliest examples of video games used for purposes beyond entertainment. From the 1987 Nintendo Entertainment System title *World Class Track Meet* (Human Entertainment, 1987) to Wii and Xbox Kinect systems that drove wide public adoption of exergames, to phone-based exergames and virtual and augmented reality—the experience offered by exergames continues to encourage players to perform physical activities by giving these activities meaning. Exergames used for the purposes of physical therapy or to promote physical exercise have been shown to be beneficial in observational studies (Fogel, Miltenberger, Graves, & Koehler, 2010), mixed-methods studies (Maloney et al., 2012), calorimetric studies (Graves, Ridgers, & Stratton, 2008; Graves, Stratton, Ridgers, & Cable, 2008), and in randomized-controlled trials (RCTs) (Primack et al., 2012; Rahmani & Boren, 2012). Because of studies such as these, exergames are one of the stable examples that demonstrate the benefit of video games in healthcare. Even off-the-shelf exergames on the Wii and Xbox Kinect platforms have been utilized for therapeutic as well as preventative purposes (Boulos, 2012; Cameirão, Badia, Oller, & Verschure, 2008; Williams, Doherty, Bender, Mattox, & Tibbs, 2011; Wollersheim et al., 2010; Yli-Piipari, Layne, McCollins, & Knox, 2016).

While exergames found success augmenting exercise and physical therapy, these successes are not always consistent in the literature. The games' effects are commonly measured outside the environments in which they were designed to be played. One of the core reasons for using video games in healthcare is to take advantage of the various mechanisms by which games elicit player motivation (Burguillo, 2010; Erhel & Jamet, 2013), resulting in health consumers being more willing to engage with the game in their free time (Savazzi et al., 2018). However, the controlled laboratory settings in which exergames are usually assessed do not reflect this play

environment, and thus do not reflect the true behaviors and motivations of participants when they access the game in on their own. As such, despite quantitative RCTs being considered the 'gold standard' for producing evidence in health research, their inability to capture the full extent of the health effects of these games in the context of everyday use creates significant drawbacks.

Purely quantitative methodologies struggle with taking into account the individual characteristics of participants and the subjective, qualitative context surrounding health-related actions (Jüni, Altman, & Egger, 2001; Nelson, Macnaughton, & Goering, 2015; Porter, McConnell, & Reid, 2017; Rothwell, 2005; Weiss, Koepsell, & Psaty, 2008), both of which can affect the burden of treatment experienced by health consumers. Medical therapies intrude into people's existing daily routine, demanding both material and mental resources from the patient and their environment (Mair & May, 2014; May et al., 2014). The investigation of the physical, cognitive, and opportunity costs for engaging in health therapy is a growing field of research (Corbin & Strauss, 1985; Leppin, Montori, & Gionfriddo, 2015). Exergames—and serious games in general—are interventions poised in-between voluntary entertainment and regimented therapy, and their effects on reducing treatment burden deserve to be explored.

It is important to remember that for all their therapeutic benefits, most exergames are still fundamentally designed first as games, employing mechanisms such as competition and narrative to motivate participation and increase retention. For example, *Wii Sports* (Nintendo EAD, 2006), one of the most commonly used exergames for health today, was created to be a social game. The presence of a community (and the social support derived from it) greatly impacts whether or not an individual who tries an activity or lifestyle will continue with it for any length of time. Other games, such as *Zombies, Run!* (Six to Start, 2012), instead increase immersion by integrating exercise into the game narrative. During this game, a player is placed in the role of a zombie apocalypse survivor tasked with retrieving supplies for a settlement of fellow survivors. As they run, gathering supplies and accomplishing objectives, they unlock more of the story and interact with other survivors, fostering a sense of competence and connection that goes beyond the satisfaction of the activity itself. There

would be little point to creating an exergame without utilizing these mechanisms given that interactive media in and of itself has no inherent ability to motivate people. Utilizing the elements of interactive design transforms blind repetitive activities, such as exercises, into engaging experiences.

Despite the positive results of purpose-built exergames, one of the most successful exergames in recent years is *Pokémon GO* (Niantic, 2016a; on its success: Althoff, White, & Horvitz, 2016), with more than 147 million players at its zenith. Though not promoted as such, as a *de facto* exergame physical activity (walking) is required to progress in *Pokémon GO*, yet the lack of emphasis on exercise in any messaging reduced the sense of cognitive burden experienced by players reluctant to exercise. It also should not be discounted how much *Pokémon GO*'s success lay in its ability to create a sense of community among its players, especially by using something other than competition via the quantified health paradigm upon which most conventional exercise apps are built (Clark & Clark, 2016). A reduction of burden (Greene & Monahan, 1989) and a sense of community (Hystad & Carpiano, 2012) are known to positively correlate with health behavior change and are utilized frequently in community-based care in the form of patient support groups.

This paper provides an overview of the current methodologies that have been used to examine the effectiveness of exergames. Just as exercise is known to bring more to holistic health than just physical enhancement, the contribution of exergames to players could well lay beyond simple improvements in physiological parameters. Common strategies employed by games to increase intrinsic motivation will also be discussed as fostering patient motivation for achieving health goals is one of the fundamental reasons for using games in healthcare.

HOLISTIC BENEFITS OF EXERGAMES

Exergames have been compared extensively to sedentary activities and standard exercise, assessed through a variety of parameters such as heart rate (Bonetti, Drury, Danoff, & Miller, 2010), oxygen consumption (Penko & Barkley, 2010), electrocardiograms (Maddison et al., 2007), and self-

reported duration of exercise (Warburton et al., 2007). These studies concluded that exergames bring about measurable physiological benefits. Specifically, RCT studies show that exergames have the potential to improve physiological parameters to an extent comparable to light exercise (Rahmani & Boren, 2012). There is ample evidence regarding the impact of exergames on physical health and fitness, as long as participants spend enough time playing such games on a regular basis.

The physiological benefit may vary depending on the type of exergame. In their meta-analysis, Peng, Lin, and Crouse (2011) found that exergames did not produce more physiological changes than standard moderate-intensity physical activity and are potentially not suitable as replacement for vigorous exercise. Exergames that mainly involve movement of the lower body have greater physiological effects than games that involve only upper body movement (Graves, Ridgers, et al., 2008). Also, studies show that child participants have higher energy expenditures than adult participants (Graves, Ridgers, et al., 2008; Graves, Stratton, et al., 2008). These findings suggest that games involving larger, more full-body movement have the highest potential to increase player energy expenditure and elevate exercise intensity, particularly for children.

Exergames have been used to improve higher cognitive function for patients recovering from stroke while also providing equal or better physiological improvements compared to standard rehabilitation (Lee, 2013; Rozental-iluz, Zeilig, Weingarden, & Rand, 2016; Şimşek & Çekok, 2016), making exergames a possible alternative therapy for these patients. Similarly, exergames were used for cognitive treatment in Parkinson's Disease, Alzheimer's Disease, and other health conditions with neurological disabilities (Mura, Carta, Sancassiani, Machado, & Prosperini, 2018). The games were found to yield comparable results to conventional therapy and participants reported a good sense of satisfaction following exergame use (Şimşek & Çekok, 2016),

Exergames can be effective for mood improvement (Li, Theng, & Foo, 2016), similar to other forms of exercise. In fact, mental health is one aspect of healthcare where serious games are known to make a significant impact (Li, Theng, & Foo, 2014; Primack et al., 2012). Exergames were specifically found to have a beneficial effect on the mood of geriatric patients (Chao,

Scherer, Montgomery, Wu, & Lucke, 2015; Rosenberg et al., 2010). In their meta-analysis, Li et al. (2016) noted that exergames that were more 'playful' (e.g., *Wii Sports*) had a significantly larger effect size for improving mood compared to exergames that were less 'playful' (e.g., *Wii Fit*, which consists of explicit fitness activities such as yoga).

Exergames may also be of interest to the growing field of 'burden of treatment' and 'patient work,' which, acknowledging that medical treatment is a major disruption to the patient's life, examine the contextual barriers that prevent patients from obtaining maximum benefit during health treatment. 'Burden of treatment' (Mair & May, 2014; May et al., 2014) and 'patient work' (Holden, Valdez, Schuber, Thompson, & Hundt, 2017) refer to the tasks—and costs—patients receiving health services or health-product consumers must undertake themselves as part of their care. As the very foundation of game-based therapy rests upon the idea that games can overcome barriers to behavioral modification by providing fun and incentives, exergames are uniquely positioned to address this emerging recognition of treatment burden. After all, patients are much more likely to adhere to therapy when they are self-motivated and do not feel an immense cognitive burden from the treatment.

SELF AND SOCIALLY-DERIVED MECHANISMS OF MOTIVATION IN EXERGAMES

With games, much like activities such as sports or exercise, *sustained* participation is rooted in how well an activity satisfies three fundamental human needs: competence (sense of efficacy), autonomy (volition and personal agency), and relatedness (social connectedness) (Przybylski, Rigby, & Ryan, 2010; Sheldon & Filak, 2008). In fact, the Cognitive Evaluation Theory (CET), a sub-theory of Self-Determination Theory (Ryan & Deci, 2000), suggests that the extent to which an activity satisfies these psychological needs strongly influences the extent to which they affect player well-being.

Drawing on the CET, the Motivational Model for Video Game Engagement (MMVGE) (Przybylski et al., 2010; Ryan, Rigby, & Przybylski, 2006) posits that two additional factors play a role with games: mastery of controls and

the experience of immersion. Mastery of controls is defined here as the learned ability to perform intended actions in a game's environment, a necessary but not sufficient condition for achieving psychologically need-satisfying play. Immersion, on the other hand, is a key moderating construct which reflects an illusion of non-mediation between a player and the gaming context, so that a player feels directly embedded within a virtual environment (Lombard & Ditton, 1997). In the MMVGE, immersion is trifurcated into the dimensions of physical presence (feeling one is actually in the world of the game), emotional presence (feeling that game events have real emotional weight), and narrative presence (the extent to which one has a personal investment and engagement with the story) (Ryan et al., 2006). Varying the level of immersion across these dimensions has been shown to affect memory of the experience (Mania & Chalmers, 2001), enjoyment of an experience (Ryan et al., 2006), and the carryover effects of content into real-world outcomes (Weinstein, Przybylski, & Ryan, 2009).

The studies on which the MMVGE was based also uncover a curious finding: many popular games are designed to satisfy psychological needs, with substantial differences in enjoyment, immersion, and pre-to–postplay shifts in well-being (Ryan et al., 2006). This is an important finding for the field of serious games—especially games for health—because the clients and grant–funding bodies that are the primary funders of these interventions often are most concerned with the intervention components and are unfamiliar with effective game design or the aspects of games that engage or immerse players (Djaouti, Alvarez, Jessel, & Rampnoux, 2011). This situation can lead to games designed for health interventions lacking features that satisfy psychological needs.

Granted, this was not the case twenty years ago, when a number of serious games like *Captain Novolin* (Sculptured Software, 1992), a Super Nintendo game in which players controlled a diabetic superhero and were tasked with managing his blood glucose levels by collecting food powerups to help him fight off aliens, enjoyed a degree of commercial success, being sold in stores alongside entertainment-focused game titles like *Indiana Jones and the Fate of Atlantis* (LucasArts, 1992). These games were no less clinically successful than those being made today, with *Captain Novolin* and similar diabetes games effectively reducing a diabetic child's likelihood of

hospitalization from a hyperglycemic crisis by 77 percent (Brown et al., 1997), as well as decreasing social stigma around diabetes and helping children speak with their friends about their condition (Satava, Morgan, Sieburg, Mattheus, & Christensen, 1995). Unfortunately, due to market pressures and downward pricing by retailers in the following decade, the edutainment industry went into a steep decline (Shuler, 2012). Today, most serious games are no longer distributed commercially, with many of their developers preferring to fund their titles in a manner that does not leave them at the mercy of the retail marketplace (e.g., grants, clients) (Djaouti et al., 2011). What few remain in this space tend to either call themselves exergames, or refrain from calling themselves serious games at all.

Two examples of exergames are *Wii Sports* (Nintendo EAD, 2006), which carries the distinction of being the bestselling single-platform game of all time, and *Zombies, Run!* (Six to Start, 2012), an immersive running game which became the highest-grossing Health & Fitness app on the Apple App Store within two weeks of release despite its high price point (Chatfield, 2012). Both of these games appear to have been designed with player need-satisfaction in mind, with several elements implemented that seem to lower the cognitive burden of the activities they promote and lower the cognitive burden of simply playing the game.

In *Wii Sports* (Nintendo EAD, 2006), players interact with the game by using the Wii Remote to mimic the actions of real-life sports. The game requires no hardware beyond what is provided by the Wii system and the motions are intuitive thanks to the Wii Remote's built-in motion sensors. This gives it a substantial advantage over games which require expensive extra hardware, especially those with a steep learning curve (and thus, a higher barrier to mastery of controls) like the Xbox Kinect. Similarly, with *Zombies, Run!* (Six to Start, 2012), the primary interaction a player has with the game is listening to the narrative while running, with the built-in accelerometer of the smartphone tracking the player's movements. No additional hardware is required, nor does a player have to do much when running, save for following instructions to speed up, slow down, or turn to escape the undead hordes.

Considering the settings in which the games tend to be played and how settings shape the resulting play experience is important. While *Wii Sports*

(Nintendo EAD, 2006) does have a robust single-player practice mode, it is far better known for its multiplayer functionality. Indeed, outside of the therapeutic context, the title is most commonly played in local multiplayer mode at parties and other social gatherings. As such, the design of the game draws upon a sense of social connectedness and playfulness to encourage people to participate and allows players to create their own narratives around competition (Li et al., 2016).

Zombies, Run!, by contrast, is a much more solitary experience: an interactive audio-book paired with a survival game, in which players are given the role of a survivor of a helicopter crash, Runner 5, through whose perspective the story of the game unfolds (Schrier, 2011). The design is highly immersive, with the protagonist's narrative synchronizing with the player's actions such as collecting resources while running, and providing meaningful choices regarding what to do with those resources that influence the course of the story. *Zombies, Run*! fosters a sense of personal investment into the events of the story, tapping into what Adrian Hon, the game's producer, calls a fantasy that many people have: that they can be the hero of their own action movie (Schrier, 2011). This is not dissimilar to the core conceit of many conventional role-playing games and the deep individual immersion they create, even if these games are interacted with via a keyboard or controller. However, such an immersive experience often requires a significant investment in time, effort, and mental energy. The burden of deeply-immersive narrative-driven games like *Zombies, Run!* tends to be balanced by the knowledge that these investments are finite—at some point, the story will come to an end.

The luxury of a finite investment is not available to health consumers diagnosed with chronic conditions, such as heart disease or diabetes, that cannot be completely cured no matter the investment they may painstakingly put into self-management. What are the tactics and techniques that may be necessary when the goal of the game—and the treatment—is to create a non-finite play experience? What are the design features that support a continuous behavior modification, keeping players motivated and returning to the game—and treatment—time and time again? Immersion, via narrative or otherwise, only works for finite periods of time. A game can release large amounts of content, but digital content in

and of itself does not necessarily generate interest. As popular games like *Wii Sports* (Nintendo EAD, 2006) suggest, fostering a sense of relatedness and creating a space which supports the growth of communities, whether formalized or not, is a strategy that motivates players to return.

Fostering this kind of community-building space usually involves incorporating multi-player elements into a game. In some of the largest multiplayer digital games, this takes the form of gameplay modes where players either find themselves pitted against one another or in group content where players cooperate to overcome a challenge insurmountable by any single one of them. Given hardware and practical limitations, these scenarios are less common in mobile applications. Many mobile games implement some sort of unit loan system—a sort of asynchronous play where one borrows a character from a friend to support them though difficult content. In either case, in-game mechanics are supplemented by online communities that exist outside the game on platforms such as forums and social media. In these virtual spaces, players can share information, show off their achievements (Ryan et al., 2006), and find general support—players can see that they are not alone—and consequently feel they are part of something bigger than themselves, even if the interactions between them and the community may be limited. Occasionally, portions of these virtual communities will be brought together at offline meetings, during conventions, expos, or more informal gatherings (Sessions, 2009). At such meetups, representatives of the developers often solicit feedback, lead attendees through bonding activities, and otherwise work to promote solidarity and connection among community members, which research has shown to increase activity in a given community (Koh, Kim, Butler, & Bock, 2007).

For players, participating in any of these multi-player mechanisms offers a way to address their relatedness needs, which are as much a key to long-term retention as autonomy or competence (Przybylski et al., 2010). The social meetings also reinforce the players' sense of emotional presence, reinforcing the meaning of continued participation in the game and affecting their activity level and length of retention in a given community, as well as their own perceived well-being (Siedlecki, Salthouse, Oishi, & Jeswani, 2014; Williams, 2006). Within the context of a game, relatedness

and connection can cushion individual players against frustrations during play, technical challenges, or boredom from repetitive tasks, while giving them opportunities to contribute to the game (such as offering support to other players) and making players feel more positive.

Notably, while multi-player options and player communities are common in successful commercial titles, they are not usually seen in titles explicitly marketed as exergames. Indeed, aside from the local multiplayer mode central to *Wii Sports,* the majority of exergames features only social media integrations that allow players to compare their fitness achievements with others or share how far they ran on a given day. While these methods are a start, they are not sufficient to foster a sense of community founded in something besides physical activity goals, meaning that the only people who seek out the exergame—if it is labelled as such—tend to be those already interested in exercise. Or, in the case of *Wii Sports* (Nintendo EAD, 2006), people who already own a Wii and want something they can play with other people.

The intent of exergames was never to make exercise more rewarding for those already doing it however, it was to reach those not currently getting enough exercise. To truly take advantage of the various mechanisms of motivation and engagement—including relatedness—perhaps there is a need for a title which fulfils the core features of an exergame but does not advertise itself as such. Or perhaps one already exists in the form of *Pokémon GO*, the augmented reality game by Niantic designed "to encourage healthy outdoor exploration and social interaction" (Niantic, 2016b).

THE CURIOUS CASE OF *POKÉMON GO*

A game grounded in the basic principles of augmented reality, *Pokémon GO* offers a relatively simple and largely single-player experience. It tasks players with acquiring virtual creatures called "Pokémon," either by capturing them when they appear on the map, or by hatching them from eggs which happens when they walk between two to ten kilometers with the egg in their possession, with exact distance depending on the type of egg. Eggs can be obtained only from interacting with "Pokéstops"

(prominent landmarks), which require players walking to them; the game uses the phone's accelerometer to prevent people from simply driving, locking players out if they were moving too fast.

Within one week of its launch in July 2016, *Pokémon GO* quickly became the most popular game in the United States (Carlon, 2016). Despite server instability and a lack of social features, the title became a social phenomenon, with over 100 million downloads during the first month (Moon, 2016), and nearly 45 million people playing every day (Anthony, 2017). In its first month, a number of articles were written citing the potential of *Pokémon GO* as a health intervention, promoting physical activity, social interaction, and more (e.g., Althoff et al., 2016; Clark & Clark, 2016; Tateno, Skokauskas, Kato, Teo, & Guerrero, 2016). Most of these were commentaries, although Althoff et al. (2016) found that users of the Microsoft Band who played *Pokémon GO* walked approximately 25% more steps on average.

In the months following its release, much of the scientific community lost interest and a number of news outlets began to report that the game started to lose significant portions of its player base (e.g., "Why Pokémon Go may have passed its peak," 2016). Many began to dismiss the game as a fad despite the game's weekly player retention rate of 75%, on par with that of other top-rated games such a *Candy Crush Saga* (King, 2012; Sonders, 2016). The high player retention rate was particularly outstanding for *Pokémon GO* given it lacked the mechanisms other games had developed over the years to raise retention rate, and the developer's lackluster response to many early technical issues (Niantic, 2016b).

In fact, *Pokémon GO* at launch was nearly devoid of design aspects that evoke social elements, either in the form of a friend system or the trading and battle systems of previous Pokémon titles. There was a primitive multi-player system in which players could have their virtual creatures defend or assault landmarks to gain "Poké Coins" (the game's premium currency) as a member of a color-coordinated team. Aside from this basic interaction, there was very little to promote a sense of community. Unlike other games that drew in new users via advertisements, *Pokémon GO*'s virality was primarily driven by word of mouth and by people posting pictures on social media about the odd places they found Pokémon (Hernandez, 2016). The

app lacked social media integration upon release, meaning that players could not simply share pictures from within the game but had to open social media applications manually. Even so, *Pokémon GO* pictures flooded Facebook and Twitter, drawing more and more people to the game, including those who may not consider themselves gaming enthusiasts or inclined to physical activity.

There are several dynamic factors that contribute to the need for physical activity and that support community development. First, the likelihood of encountering each species of Pokémon depends on location, time of day, terrain, and other environmental conditions, making it difficult to know what is likely to be found at any given location. Rare Pokémon can be lured to Pokéstops if players place a lure module, making the process of catching the creatures far less tedious. Lure modules are rare to find and expensive to buy, but there are certain locations—usually parks, shopping malls or other large public spaces—where Pokéstops may overlap each other. Due to high volume of traffic, there is a higher chance a player will have placed a lure module at these places. These areas become real-life locations where *Pokémon GO* players congregate—*de facto* community hubs where people come with their phones (and chargers) to talk about Pokémon, catch Pokémon, and to spend time in general. After all, since the virtual creatures do not permanently exist in the landscape and there is no indication of what Pokémon will spawn, players who wanted to "catch 'em all" had to spend time walking, waiting, and inquiring about where certain creatures may be from others.

The very lack of social features within the game necessitated players to communicate via social networks, consult online databases and unofficial online maps, and attend local player gatherings. In a major public relations gaffe, Niantic shut down the unofficial maps, declaring that they violated the terms of service and were not how the game was intended to be played. As time went by with no official replacement for the maps and no word on when something would be implemented to fill the niche, many previously avid users eventually stopped playing.

By the start of 2017, the number of daily active users shrank from 45 million to 5 to 8 million (Anthony, 2017; Windels, 2017), where it stabilized. While this is a steep reduction from the original number of *Pokémon GO*

players, it is still comparable to the figures of other major mobile games such as *Clash of Clans* (Supercell, 2012; Sonders, 2016). To put things in perspective, *Clash of Clans* (Supercell, 2012) is not only one of the most popular mobile games in the world, it was also the first to reach $2 billion USD in global revenue (Blacker, 2018). Saying that these games *merely* have 5 to 8 million daily active users is itself misleading. At the same time, the rate of monetization was higher for *Pokémon GO* compared to *Clash of Clans*. *Pokémon GO* set records for the mobile game industry by reaching $500 million in global revenue in 2 months and reaching the milestone of $2 billion USD in approximately the same timeframe as *Clash of Clans*, demonstrating that *Pokémon GO* has become more effective at monetizing from a smaller audience (Blacker, 2018). And, unlike *Clash of Clans* (Supercell, 2012) and its contemporaries, which make players pay to skip long wait timers, buy extra lives, and the like, *Pokémon GO*'s only monetization options are its item shop and its avatar costumes. None of these premium items are necessary for the full play experience—an experience which has only grown richer after the re-implementation of a tracker system, a re-design of the battle system, a friend and gifting system, a buddy system where one "walks" with a chosen Pokémon, and the addition of "raid" content, which can only be completed in cooperation with other players.

Today, there are no more mobs of people wandering the streets playing *Pokémon GO*, and many of the large forums and subreddits lay silent. Yet it would be wrong to say that *Pokémon GO*'s time has passed. In every major city, there are groups of players (each with their own Facebook groups) ready to gather for a raid target, even if they no longer walk for kilometers in search of Pokémon, having already "caught them all." With new exclusive creatures being released, the recent launch of several Nintendo Switch titles that benefit from player actions in the mobile game, and the highest user numbers the game had seen since 2016, perhaps a *Pokémon GO* resurgence is near at hand.

LESSONS LEARNED FROM *POKÉMON GO*

Pokémon GO provides a number of lessons for exergame design. As a game that was never marketed as a health app, it still effectively improved

physical activity outcomes and did so to a vast population in a more *consistent manner* than any traditional exergame (Althoff et al, 2016; Meschtscherjakov, Trösterer, Lupp, & Tscheligi, 2017; Wagner-Greene et al, 2017). Notably, social connectedness and perceptions of physical or virtual community—vital for *Pokémon GO*'s dissemination—are also areas that previous health games have not given enough thought. Despite the game's commercial success, it is difficult to measure its impact on a large and holistic scale without proprietary data access, as the only data typically accessible are from those who already use various health apps and related tools to self-track activity. Investigating game data or devoting more efforts into modifying existing methodologies may be the necessary next steps for the field of exergame research to further its credentials and reach. Still, as indicated in Table 1, *Pokémon GO* features a collection of good exergame design features as reviewed earlier in this paper, which combine to form its success.

According to Yang & Liu, the motives for which people play *Pokémon GO* were found to be associated with wellbeing (2017). Those who play *Pokémon GO* for fun benefited the most from the game experience, reporting higher perceived bonding, physical health, and reduced loneliness. Those who play to maintain existing relationships also reported higher satisfaction with life, indicating better mental health. Results in other areas are mixed. While Yang and Liu (2017) report that playing for nostalgia resulted in higher feelings of loneliness, they also report a high correlation between nostalgia and both friendship maintenance and relationship initiation. Another study found that *Pokémon GO* in fact resulted in a higher sense of belonging, with nostalgia fostering a deeper sense of connectedness (Vella et al., 2017). Players playing for escapism, however, reported on lowered life satisfaction (Yang & Liu, 2017)—an indication that despite reaching similar physiological goals, the motivations behind playing exergames matter greatly for players' holistic health outcomes (Clark & Clark, 2016).

Exergame design feature	Implementation in *Pokémon GO*
Lower body exercise instead of upper body exercise	Focusing on using walking to find and hatch Pokémon
Target a younger audience	Pokémon models focus on 'cute' designs
Competence	Simple controls and shallow learning curve
Autonomy	No set exercise goals
Relatedness	Main character is a player insert
Mastery of controls	Simple controls and shallow learning curve
Experience of immersion	Exercise has a purpose and meaning (finding and hatching Pokémon)
Allows for social interactivity	Encourages physical interactions between players due to Pokémon congregating in certain locations
Sense of community	Physical gatherings, existing Pokémon fanbase
Novel and fun features	Augmented reality gameplay

Table 1. Good exergame design features in *Pokémon GO*

It is also important to remember that *Pokémon GO* benefited from a vast and long-running existing multi-media property. Nintendo's *Pokémon* was initially designed to have walking as a meaningful part of the gameplay and gathered a faithful community of players over more than twenty years, a feat that many other exergames cannot claim. The existence of an established player community and incorporation of walking in-universe gameplay helped *Pokémon GO* greatly. Moreover, just like all health interventions, participants need to be aware of negative effects from exergames. Players who play *Pokémon GO* while driving, or walking without paying attention to their surroundings, pose potential dangers to themselves (Wagner-Greene et al., 2017). Approximately 43% of players surveyed by Wagner-Green et al. reported they are likely to play *Pokémon GO* while riding a bike, and 37% reported they are likely to sacrifice sleep to play more of the game (Wagner-Greene et al., 2017). The full extent of

effects from exergames thus requires more research, with trials that take these traditionally unexpected adverse effects into account.

TRIAL DESIGN FOR EXERGAME STUDIES

To emulate the natural environment that games are played in, trials for exergames should avoid enforced play at the very least. When exergames are examined in an enforced setting, the group subjected to the intervention is not playing out of their own volition, in a comfortable setting or a timeframe that fits naturally into their daily lives. It is therefore no surprise to see study participants starting to report exergames as boring after a few weeks of enforced play, especially if these participants have unconsciously started to perceive the game as a burden or a chore (Madsen, Yen, Wlasiuk, Newman, & Lustig, 2007). Disliking a game is one of the most significant factors contributing to participant discontinuation of serious games; even if players continue playing, it increases their cognitive burden and voids the positive impact a game may have had (Heeter, Lee, Magerko, & Medler, 2011).

The assumption that games, like drugs, can exert their physiological effect regardless of a participant's inclinations or motivation, is fundamentally flawed. It is therefore heartening to see that exergame researchers have already taken steps to modify and create methodologies to better fit the nature of games. There are more studies that examine the mental benefits of exergames and some studies have also included intervention groups where the participants were merely *provided* with a given game, rather than being forced to play for a set amount of time per day (Garde et al., 2016; Klompstra, Jaarsma, & Strömberg, 2014). In such studies, the only difference between the intervention and the control groups was whether the participants had access to the game software (or in some cases, the hardware the game required), not whether or not they were observed to play, mimicking the realities of community-based behavioral health interventions.

In one study of older adults in Sweden, participants were provided with a Wii console and the *Wii Sports* game, together with an instruction session (Klompstra et al., 2014). Participants also had access to an instructor via

telephone if they needed technical assistance during the trial. It is interesting to note that while participants only received a vague suggestion regarding play requirements—that of "playing 20 minutes per day by themselves or with others"—the mean playtime in the trial was 28 minutes per day per person, exceeding that of the recommended daily play time (Klompstra et al., 2014). It is possible, therefore, that trials do not have to rely on enforced participation for participants to gain the benefit of the exergames, unlike in traditional RCTs where strict adherence to the intervention is vital.

Other methods can be used to examine player agency. For example, a study with school children and a mobile-based exergame (Garde et al., 2016) employed a protocol that consisted of within-subject comparison (the participant's exercise baseline data was used for pre and post comparison), a washout period (participants were monitored for a week after losing access from the game), and alternating exposure to the game (the two groups of participants received access to the game during different time periods). In a study such as this, the intervention was not so much 'playing the game', but 'being exposed to the game', retaining the sense of autonomy that is particularly important for the development of intrinsic motivation. The inclusion of a washout period is also important, as it allows observation for any residual effects of game exposure, or if other factors were confounding the amounts of exercise the participant conducted. As the study showed the amount of physical activity performed during the participants' baseline week and washout week were not significantly different, the study showed a relationship between playing the game and participating in more exercise.

The impact of global hits such as *Pokémon GO*, on the other hand, enable participant numbers at a scale not seen before for exergames. In their anonymous trial involving 32,000 Microsoft Band users, Althoff et al. (2016) identified *Pokémon GO* players through the users' search engine history. Microsoft Band users who actively searched for *Pokémon GO* tips online were assumed to be playing the game. The study found there was a significant increase in step counts (~25% increase in step counts compared to prior activity levels, $p < 0.001$) for these participants in the first 30 days after the launch of *Pokémon GO* (Althoff et al., 2016). The authors

note that *Pokémon GO* had a beneficial effect for all players irrespective of age, gender, or other factors, and that a higher number of internet searches for *Pokémon GO* tips was correlated with higher increases in step counts (Althoff et al., 2016), indicating that interest (and potential engagement) in the game could be directly related to increased exercise. It is possible that these results are limited to those people who own Microsoft Bands and who may already have a greater interest in health and wellness, yet the study manages to draw data about the intervention—and related activity (e.g. internet searches)—from a number of participants impossible to achieve without the size and proprietary access granted by Microsoft's partnership. These findings were only possible due to the authors' affiliation as Microsoft employees at the time, which also provides a positive example of the exergame research community benefiting from working with similar companies.

In seeking to study the effects of *Pokémon GO*—or other commercialized exergames whose success is tied in part to good mechanics in design—it may prove necessary to pursue collaborations with the companies developing such titles, as the data they possess on player engagement, retention, and activity is by necessity more comprehensive—and analytically accessible—than the proxies used in existing exergame studies. In particular, such collaborations can shed light on the details behind observed social effects and boosts in motivation, and in turn yield valuable insights on optimal design for such games for health.

CONCLUSION AND RECOMMENDATIONS

Exergames, by their interactive nature, are more than simply another prescribed drug. Without patient input and participation, the long-term promise of behavioral modification through exergames cannot be reached in healthcare despite their demonstrable short-term benefits during periods of enforced play. Such controlled consumption of the medium in no way taps into the rich potential of self-motivation that good games are designed to elicit from their players. Exergames are also beneficial to players beyond merely improving their physical fitness in ways that standard interventions struggle with, due to the immersive and participatory nature of the games—e.g., improved cognitive functions,

mood-improvement, and an increase in the internal perception of well-being.

To capture the true scope of these benefits, it is therefore necessary for researchers to modify the methods we currently use to assess and validate therapies in the healthcare sphere. Progress has already been made in designing trials that take into account the beneficial effects of voluntary play, while maintaining the rigor of controlled trials. To assess the full scope of advantages that exergames bring to community care, researchers need to have trials that address the 'invisible' benefits of such interventions such as reductions in perceived treatment burden, which is known to affect adherence rates and thus health outcomes. Alternative data sources, such as data from developers, may need to be accessed to analyze such changes on a population scale.

At the same time, exergame design would do well to keep the holistic benefits of gaming in mind. As perhaps the most prolific exergame in history, *Pokémon GO* has many lessons to offer those designing and researching exergames regarding the factors that led to its success and its ability to retain a large, loyal base of players. Research is necessary on the nature of the real-life connections and communities *Pokémon GO* supports, specifically the factors which give rise to them and sustain them, and whether the social factors which made the game a success can impact player wellbeing. Another research direction involves examining other game-based communities and seeing what lessons they may have for exergames and serious games as a whole. *Pokémon GO* also validated past work regarding player motivation, and highlighted the importance of social factors in play. This aspect of the game is something that exergame developers can certainly learn from.

Good games are more than a collection of tasks and goals. Good exergames should motivate the player to continue participating in the therapeutic intervention, as well as reducing the cognitive burden involved. Ultimately, the goal for exergames isn't to have the player constantly engaged with the game, it is to allow players to change their lifestyle by way of playing the game. The study of serious games, rooted in human psychology, has found that factors such as social relatedness, a sense of belonging, autonomy, and feelings of competence are essential qualities

of a good game—more so than flashy graphics or the use of sophisticated technologies such as augmented reality. In the end, while games can achieve more than a list of tasks can ever manage, they can only do so if one is designing them with the player in mind, treating the game not as a simple prescription for a patient who needs treatment but as an option for a person with limited time and energy, who has the ability to make choices about their life and wellness.

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Using Games to Support STEM Curiosity, Identity, and Self-Efficacy

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ABSTRACT

In this study, we examine how we might design and use games to support Science, Technology, Engineering, and Mathematics (STEM) learning as well as relevant social and emotional learning skills such as self-efficacy, curiosity, and STEM identity. We investigate a deck-building card game, *Assassins of the Sea* (Killer Snails, 2017), which teaches about marine biology, ecology, and environmental science. 178 middle school participants played the game and took an assessment before and after the game. Our results suggest that players' STEM knowledge increased significantly. We also share social and emotional learning results, identify gaps, and make initial recommendations for creating and using games for STEM learning.

INTRODUCTION

How can we use and design games to better support the learning of Science, Technology, Engineering, and Mathematics (STEM) fields, while **also** supporting social and emotional skills—such as self-efficacy, curiosity, and identity—which have been found to be interrelated to STEM performance, learning, identity, and career interests? This paper investigates a STEM game, *Assassins of the Sea* (Killer Snails, 2017), which

has both digital (mobile) and physical versions, and was created by game developer Killer Snails in partnership with the American Museum of Natural History. *Assassins of the Sea* is a deck-building card game, where players need to compete to find a winning cure from the peptides of deadly marine snails. The game is targeted toward middle and high school students and is connected to Next Generation Science Standards (NGSS; https://www.nextgenscience.org/).

The goal of *Assassins of the Sea* is to help support STEM learning, particularly of ecological and environmental processes, as well as to spur innovative thinking and scientific curiosity. As a country, the United States has simultaneously dropped out of the top 10 innovators globally (Jamrisko & Lu, 2018) while American 10th-graders are currently ranked 25th in science worldwide (Kastberg, Chan, & Murray, 2016). Moreover, a full 46% of the American Association for the Advancement of Science (AAAS) scientists rank K-12 STEM in the United States as "below average" (Funk, Rainie, & Page, 2015). Lagging student achievement in STEM is compounded by recent findings that 57% of middle school students say "science is not me," suggesting that a majority of students do not identify as having a "STEM identity" and further fueling the need for improved STEM curriculum that engages learners while providing teachers with feedback to inform future instruction (Aschbacher & Tsai, 2014). Regardless of whether these data points are correlational or causal, they indicate a concerning trend around STEM that is detrimental for our youngest learners. Strategies to increase the U.S. ranking in STEM are complex and have largely focused on improving rigor in STEM teaching (Honey, Pearson, & Schweingruber, 2014; Klahr, Zimmerman, & Jirout, 2011). As schools of education are tasked with educating future STEM teachers, they continue to seek out the most effective methods of engaging learners and are quick to embrace technologies that teachers may use to engage their students more deeply (Yasar & Veronesi, 2015).

Recent research suggests that shifting from a focus on teachers to the system of teaching has the potential to significantly improve student learning outcomes (Hiebert & Stigler, 2017). This suggests that simply looking at individual educators without observing the methods and practices they employ or larger systemic factors (such as social and

emotional components) may limit our ability to improve educational outcomes for our students. Given a similar curriculum, teachers themselves did not account for as much of a difference in learning nor did the teacher's ability to polish each lesson to perfection. While finely honed systems of teaching seem to improve knowledge, research suggests that content alone is not enough to tip the scale toward more successful learning outcomes (Demetriou, 2018). What are some methodologies that may also support STEM learning, social and emotional learning, and purposeful learning? Research suggests that these can include problem-based learning and implementing digital tools. What effective methodologies have in common are mutually agreed upon learning goals aligned to instructional objectives that allow for rich assessments to improve the practice of teaching in a particular domain (Gotwals & Songer, 2013; Kloser, Borko, Martinez, Stecher, & Luskin, 2017). Learning goals provide a target for learning while formatively assessed objectives scaffold each student's pathway and provide a feedback loop for learners to improve their understanding.

For instance, instead of delivering rote lessons, effective teaching may instead include individualized and active instruction that is presented in the context of solving a problem. Presenting a lesson in this way helps students feel more purposeful in their learning. Furthermore, this sense of purpose taps into a student's sense of social-emotional wellbeing. Cohen (2006) suggests that pedagogical practices have the opportunity to embed important skills of self-expression and empathy into current methodologies. In fact, a growing consensus suggests that focusing on the social and emotional states of learners may significantly impact learning outcomes including sense of efficacy in the classroom (Riem, Ciotto, &Abbott, 2017). Enhancing social-emotional learning (SEL) outcomes can improve learning outcomes while building a sense of autonomy and competence in coursework (Zins, 2004). According to Zins and Elias (2007), SEL relates to the "capacity to recognize and manage emotions, solve problems effectively, and establish positive relationships with others" (p. 234), SEL has been shown to increase reasoning, raise academic achievement, and positively impact behavior and attitudes of learners (Zins, Elias, & Greenberg, 2003).

In this paper, we investigate results from a study on students playing *Assassins of the Sea* in middle school classrooms. We seek to better understand how to use games to enhance SEL alongside STEM learning, and how enhancing SEL, self-efficacy, and STEM identity with games may be connected to greater STEM learning outcomes and interest in STEM careers. We ask, are games are an effective way to support STEM knowledge while also supporting SEL skills?

GAME-BASED LEARNING AND STEM

Games have increasingly been used to teach content and skills in a variety of contexts, including school, afterschool programs, home, and libraries (Schrier, 2018). Takeuchi and Vaala (2014) found that 74% of K-8 teachers use games, and 55% of teachers use games at least once a week, in their classroom to improve instruction. This makes sense given 91% of young children are considered gamers, making games for learning an ideal medium to engage learners and broaden STEM participation (Reisinger, 2011). With 64 million kids playing games nationwide it is important to meet students where they are while clearly delineating pathways for teachers to successfully implement technology in the classroom to improve instruction. While a significant number of students and teachers use digital games for learning, 33% of K-12 teachers have shied away from integrating technology into the classroom due to issues of implementation, curricular fit, or lack of professional development to support implementation (Cohen & Hill, 2008; Rebora, 2016). Broadening technology access is one way we can increase wider participation in STEM while providing critical skills for our students to be competitive in the global economy. To address this issue, there is a need to carefully define practices for the implementation of innovative technologies while providing evidence-based research on how these tools improve student learning to transform the process of teaching and learning (Hiebert & Stigler, 2017).

Games have been used to teach topics such as history and historical thinking (Schrier, 2014), literacy acquisition (Ferdig & Pytash, 2014), and music (Hein, 2014), as well as STEM knowledge and skills such as computational thinking skills (Werner, Denner, & Campe, 2014) and medical and health information (Bertozzi, 2014). Games that are used for

learning can be made specifically for educational purposes, such as *Assassins of the Sea* or the Federation of American Scientists' *Immune Attack* (2008), or can be commercial off-the-shelf games that are adapted for an educational purpose, such as *Civilization* (MPS Labs, 1991) or *Assassins Creed* (Ubisoft, 2007). They can come in all shapes and sizes, genres, and platforms, from large MMO (massively multiplayer online) games like *World of Warcraft* (Blizzard Entertainment, 2004), to mobile math games such as *DragonBox* (WeWantToKnow AS, 2012), to classic outdoor playground games like hopscotch. Games can be made to teach almost anyone: from preschoolers and babies, veterans, college students, or older adults. Many terms have been applied to these types of games, from educational games, to serious games, or "gamification." Regardless of the term used, these are games that are used or designed to help a particular audience learn a new skill, topic, concept, attitude, behavior, and/or express, connect, and/or develop in a substantive way.

Games, at least theoretically, seem appropriate for learning about complex systems, such as those related to the STEM fields. Biological processes, such as photosynthesis and nutrition, are often not straightforward concepts but complex "'living, breathing' social, cultural, economic, political, and scientific systems with many interconnecting parts, which—to be fully understood—need to be embraced holistically and systemically" (Schrier, 2018, p. 896). Likewise, games are dynamic systems that can help contextualize meaning and simulate the complexity of a STEM-related field. While games cannot possibly simulate every aspect of a dynamic, rapidly-changing system, they can help us to grapple with some of these complexities using authentic data, information, tools, contexts, actions and skills (Schrier, 2018).

Although research has suggested that games can be effective for learning skills or shaping attitudes (Crocco, Offenholley, & Hernandez, 2016; Sitzmann, 2011), efficacy often depends on a number of factors, including context, teacher expertise, student prior knowledge and attitudes, and the design of the game (Clark, Tanner-Smith, & Killingsworth, 2016; Schrier, 2018). For example, Crocco et al. (2016) analyze English lessons using games in math, science compared against nongame lessons. They found that using games in lessons correlated with enhanced enjoyment of

learning, which related to higher-order thinking and deeper learning, showing that perhaps the increased enjoyment that games inspire can also support greater learning (Crocco et al., 2016). A meta-analysis of 225 studies found that active learning, including game-based learning, increases student learning outcomes by 6% overall in STEM fields with even stronger impacts for underrepresented students (Freeman et al. 2014). There is significant evidence of the impact of digital games on amplifying student interest (Klahr et al. 2011; Squire & Dikkers, 2012), increasing the collaborative construction of knowledge (Duncan & Rivet, 2013), and extending inquiry (National Research Council, 2011).

On the other hand, Wouters, van Nimwegen, van Oostendorp, and van der Spek (2013) compared the use of games to typical methods (such as lectures, and skill and drill practice, and found that while games were more effective in learning (from a cognitive perspective), they were not necessarily more motivating. Rather than the game itself being the cause of whether learning happens, Clark et al. (2014, 2016) found that it is the design of the game and the learning environment that mattered more, suggesting that there are many complex factors, around and within a game, which can work to support or limit learning. A question, therefore, is the extent to which SEL is a factor around gaming that may contribute to (or even limit) learning.

SOCIAL EMOTIONAL SKILLS, STEM, AND GAMES

As mentioned in the previous section, SEL outcomes and skills, such as motivation, may be factors in whether a game (or any learning experience) is effective. Are STEM games more effective when they support the cultivation of social and emotional skills alongside STEM-related skills and concepts? To understand this, we need to first understand the interconnections among STEM learning in general, and social and emotional skills. For instance, how do one's identity and self-efficacy around learning STEM (seeing oneself as "good at STEM") affect achievement in STEM fields and desire to work in STEM fields, regardless of actual STEM ability.

SEL programs can be effective for overall learning and academic

performance. In a meta-analysis, Durlak, Weissberg, Dymnicki, Taylor, and Schellinger (2011) investigated 213 SEL programs at schools and found that these types of programs can enhance social and emotional skills, behaviors, and performance in academic achievement. Likewise, a more recent meta-analysis done by Taylor, Oberle, Durlak, and Weissberg (2017) looked at 82 SEL programs in and out of the United States and found that social-emotional skill development was the best predictor of well-being for students and benefits were seen regardless of socioeconomic status, race, or where the school was located.Self-efficacy has been shown to affect academic achievement (Shams, Mooghali, Tabebordbar, & Soleimanpour, 2011; Xu & Jang, 2017) and motivation and performance in general (Komarraju & Nadler, 2013; Xu & Jang, 2017). In particular, self-efficacy plays a key role in shaping interest and achievement in STEM fields, as well as in the pursuit of careers in STEM (Lent, Brown, & Hackett, 1994; Roue, 2007; Skaalvik & Skaalvik, 2006, 2015). Social Cognitive Career Theory (SCCT) explains that self-efficacy and interest in STEM, coupled with environmental and individual attributes, may affect how someone decides on a career path (Cantrell & Ewing-Taylor, 2009; Hayden, Ouyang, Scinski, Olszewski, & Bielefeldt, 2011; Lent et al., 1994; Wang & Degol, 2013;).

Self-efficacy also affects one's social identity around STEM topics (Flowers & Banda, 2016) and gender, race, class, and ethnicity factor intersectionally into whether students feel a sense of inclusion in their learning experiences (Delgado & Stefancic, 2017[2001]). One's social identity affects and drives learning and growth (Kim, Chang, Choi, Park, & Kim, 2018), including one's sense of belonging (Cheryan, Master, & Meltzoff, 2015). Stereotype threat (Shapiro & Williams, 2012) is also useful to mention, as social identity and self-efficacy are factors in how students may navigate this challenge. Stereotype threat, the fear of living up to the negative stereotypes that an individual hears about one's group or one's identity, affects the performance and achievement of those belonging to marginalized groups (such as women and people of color) and may lead to disengagement in STEM and other domains (Woodcock, Hernandez, Estrada, & Shultz, 2012; Woodcock, Hernandez, & Shultz, 2016). Kim et al. (2018) looked at STEM experiences in middle and high school. They found that social environment affects STEM identity and concepts about who belongs in STEM can be changed with interventions. This research suggests that games that teach

STEM knowledge should couple STEM information, models, and simulations of a game with ways to support social and emotional skills—such as increased self-efficacy around STEM, greater STEM curiosity, and enhanced identity around STEM—as these may as important to the success of the game.

Research from games and intervention programs also support this. Enrichment programs can excite interest in STEM by enhancing scientific curiosity, which in turn leads to high scores of self-efficacy around science and also higher STEM knowledge (Ogle, Hyllegard, Rambo-Hernandez, & Park, 2017). Leonard et al. (2016) used robotics and game design to enhance self-efficacy around STEM for middle school girls and indigenous populations. They looked at middle school students' self-efficacy in technology, attitudes toward STEM/STEM careers, and computational thinking strategies. They found that students who participated in blended robotics/gaming clubs had higher self-efficacy scores, which was related to their participation in the construction of videogames and creating effective game prototypes (Leonard et al., 2016). Likewise, Çakir, Gass, Foster, and Lee (2017) used a game design workshop to help support young women's interest in computing by encouraging them to develop identities as computer scientists.

More generally, feeling a sense of belonging and inclusion in a game community may also contribute to learning (McGonigal 2011; Schrier, 2016). Social interactions and a supportive community of learners in a game, can in turn also motivate further game playing and problem-solving, (Eseryel, Law, Ifenthaler, Ge, & Miller, 2014; Yee 2006). For example, according to Inkpen (1994), players who shared a computer while playing a game were more motivated and exhibited greater learning, possibly because they had to express ideas out loud, helping to reinforce their learning.

Other authors suggest that games can support the development of social and emotional skills in addition to more disciplinary skills. Skills related to compassion and empathy such as perspective-taking, cultural awareness, and reflection (Belman & Flanagan, 2010; Darvasi, 2016; Schrier & Farber, 2018); ethics and ethical thinking, such as argumentation, deliberation,

and consideration of others viewpoints (Ryan, Staines, & Formosa, 2016; Schrier, 2015, 2017); other skills such as communication, social awareness, personal expression, and collaboration (Foster & Shah, 2016a; Foster & Shah, 2016b; Shah & Foster, 2018; Steinkeuhler, 2007; Steinkuehler & Oh, 2012;) and emotion expression and emotional and mental health (Dunlap, 2018; Isbister, 2016; Vacca, Bromley, Leyrer, Sprung, & Homer, 2014;). However, more work is needed to understand how to better design games that both support these types of social and emotional skills, while also supporting and encouraging STEM knowledge acquisition and understanding. In this paper, we seek to share initial findings of a STEM-related game that aims to support the enhancement of STEM curiosity alongside STEM knowledge. We also share best practices and recommendations for moving forward with understanding this relationship, and how we can use games to better support it.

METHODS

To analyze the STEM learning goals and STEM interest and identity, 197 middle school participants were invited to play a game, *Assassins of the Sea*, in their classroom. Pre- and post-tests were used before and after the game. *Assassins of the Sea* was chosen for several reasons: (1) We had free access to the game; (2) The game was designed to support both STEM learning and SEL learning; and (3) The game aims to support skill development related to the five core SEL competencies including relationship skills, self-management and decision-making (CASEL, 2018; Dunlap & Rivers, 2018). Dunlap and Rivers (2018) share best practices and a checklist for analyzing games for use in social and emotional skill development in teens. We found *Assassins of the Sea* to meet twelve of the thirteen categories in their checklist (please see Appendix I).

About Assassins of the Sea

Assassins of the Sea is a deck-building card game created in partnership with the American Museum of Natural History through iterative playtesting with middle and high school students. The goal of this game is twofold. First, the game uses extreme creatures (cone snails) to engage students in

science learning. Second, the game places students in the role of scientist and in doing so, improves their efficacy and their belief that they can take on the role of scientist. While there are tabletop and digital versions of the game, the digital version has been researched within both public district and charter schools. In this study, the digital version of the game was used for our investigation. In the game, players play as scientists racing to create a winning medicinal cure drawn from the peptides of venomous marine snails. Players must conduct research to identify the peptide solution and feed their snails specific prey to generate peptides in the winning solution. Just as in real life, the peptides that are deadly to the snail's prey are also the source of palliative treatment for humans. The student plays as a scientist trying to collect the peptides that will create the winning peptide cocktail. The peptide solution is revealed during game play through various actions.

Student scientists can use research cards to peek at specific peptide groups called "cabals." When certain snails are fed they may reveal peptides to all players. Over time more peptides are revealed as a result of additional action cards and players can then see which peptides their snails must generate to create the winning treatment. Snails have varying diets of fish, mollusks, or worms which also generate different peptides. Game play moves quickly as players may only make one move per turn which includes: putting a snail into play, feeding a snail, purchasing cards from the market, or using an event card. Players learn from one another, revising their strategies throughout game play. Event cards allow players to enact different strategies while modeling various aspects of scientific inquiry from research to publications and replicating real-world phenomena impacting the snails' habitats from tidal waves and tsunamis. The goal of gameplay is to use science to keep your snails alive and fed until they are able to successfully generate the winning peptide solution resulting in a palliative treatment.

Participants

The study took place at two middle schools across a socioeconomically and ethnically diverse metropolitan public school system in the northeast United States, a public school and a public all-girls charter school. A total

of 197 students (137 females, 60 males) engaged in game play for this research (see Table 1). Students from 6th-, 7th-, and 8th-grade were included in this sample of convenience, with significantly more female than male students. Classroom teachers self-selected to participate in this experience as a substitute experience for a life science class where topics of biodiversity, predators and prey, and scientific methods were typically instructed. A total of ten different groups of students participated, five from each of the two schools.

Gender	Grade	*N*	%
Female	6th Grade	16	8%
	7th Grade	33	17%
	8th Grade	88	45%
Male	6th Grade	15	8%
	7th Grade	45	23%
Total		197	

Table 1. Descriptive statistics for participants engaged in AOTS game play

Materials & Procedures

To conduct the study, researchers instructed the participants at the beginning of each 45-minute class period to collect their own laptop computer from a laptop cart at the front of the classroom. A do-now was written on the board prompting students to independently respond to a pre-assessment through Google forms. The "do now" was a pre-test used to establish a baseline of prior knowledge before game play (e.g., what is a cone snail, what are its predators and what are its prey, why are scientists interested in studying cone snails). Students were encouraged to give their best possible answers or leave responses blank if they did not know the answer. Table 2 includes the items used to assess knowledge, pre and post gameplay.

Once students submitted their pre-assessment responses they were instructed to close all but one laptop per group. Once extra laptops were

closed, students were invited to begin playing *Assassins of the Sea* in small groups of three to four. Students launched the digital version of *Assassins of the Sea* from a single shared laptop per group and took turns manipulating the laptop during their turn. Teachers and researchers circulated to observe students during game play and assist in technical issues. Students were asked to end gameplay 10 minutes before the end of the class period to take the post-assessment. The post-assessment included the same seven questions as the pre-assessment. In addition, there were three open-ended questions about scientific identity and interest in STEM careers.

Results

To determine whether or not there was a significant change in student understanding of STEM concepts after AOTS gameplay, we conducted a repeated measures ANOVA with pre- and post-assessments collected over time as a within-subjects variable and gender and grade as between-subjects variables (Table 3). The analysis revealed a main effect of gameplay on student scores between pre- and post-assessments ($F(1, 192) = 234.46$, $p = .000$), where student scores improved after a single session of game play. Results also indicate a main effect of grade ($F(2, 192) = 6.34$, $p = .002$) where students in 8th grade had higher mean scores both pre- and post assessment (respectively, Ms = .98, 2.57) than students in the 6th- (respectively, Ms = .32, 2.35) or 7th-grade (respectively, Ms = .41, 1.98). A post-hoc Tukey test indicates a significant difference between the scores of 7th- and 8th-grade student ($p = .000$). No significant between-subject effects were found between student score and gender and no significant between-subject interactions were found between the three factors of score, gender, or grade level.

	Mean Pre-Test	SD	Mean Post-Test	SD	*N*
What makes cone snails deadly?	0.16	0.37	0.64**	0.48	196
What are the three types of prey that cone snails hunt?	0.01	0.07	0.47**	0.42	196
What are some predators of cone snails?	0.02	0.12	0.26**	0.44	197
What are three ways that scientists share their findings?	0.36	0.45	0.40	0.44	195
Why do scientists study cone snails?	0.04	0.20	0.19**	0.39	197
What are some environmental factors that affect cone snails?	0.03	0.11	0.24**	0.38	197
How do the environmental factors listed above affect cone snails?	0.29	0.45	0.38*	0.49	197
Total Score	0.65	0.73	2.31**	1.50	197

* p = .001; ** p = .000

Table 2. *Paired t-test for question asked before and after AOTS game play across all students*

Once an overall significant difference in student scores between pre- and post-assessments was established, we looked closely at each specific question to determine which aspects of science knowledge were most impacted by game play. A series of paired t-tests were conducted to evaluate changes between pre- and post-assessment scores on each of the individual test items (Table 2).

Time	Gender	Grade	Mean	SD	*N*
Pre-Test	Female	6	0.36	0.43	16
		7	0.45	0.54	33
		8	0.98	0.82	88
		Total	0.78	0.77	137
	Male	6	0.28	0.46	15
		7	0.38	0.58	45
		Total	0.35	0.55	60
	Total	6	0.32	0.44	31
		7	0.41	0.56	78
		8	0.98	0.82	88
		Total	0.65	0.73	197
Pre-Test	Female	6	2.24	1.53	16
		7	1.78	1.29	33
		8	2.57	1.56	88
		Total	2.34	1.52	137
	Male	6	2.47	1.23	15
		7	2.18	1.53	45
		Total	2.25	1.45	60
	Total	6	2.35	1.38	31
		7	2.01	1.44	78
		8	2.57	1.56	88
		Total	2.31	1.50	197

Table 3. Mean pre- and post-test scores for students engaged in AOTS game play

Student understanding significantly increased across six of the seven assessment items including the average score between pretest (M = .65, SD = .73) and post-test (M = 2.31, SD = 1.50), $t(196) = -17.10$, p = .000. Students showed significant improvement between pre- and post-tests demonstrating an improved understanding of why scientists study venomous cone snails, their predators, and their prey, and a greater understanding of what and how environmental factors impact the snails' livelihood. Specifically, student understanding about why the snails are deadly increased significantly between pre-test (M = .16, SD = .37) and post-test (M = .64, SD = .48); $t(195) = -12.65$, p = .000). Student knowledge about

the snails' prey also improved significantly between pretest (M = .00, SD = .07) and post-test (M = .47, SD = .42); t(196) = -15.74, p = .000. Students understanding of predators significantly improved between pretest (M = .01, SD = .12) and post-test (M = .26, SD = .44); t(192) = -7.45, p = .000. After a single round of game play student understanding about why these snails are studied improved significantly between pre-test (M = .04, SD = .20) and post-test (M = .18, SD = .39); t(196) = -5.22, p = .000. Additionally, students were significantly more likely to identify environmental factors that impact these snails between pretest (M = .03, SD = .38) and post-test (M = .24, SD = .45); t(196) = -7.50, p = .001. What's more, not only were students significantly more likely to identify the environmental factors impacting venomous cone snails, they were also significantly more likely to explain how these factors impact the ecosystems of these extreme creatures between pretest (M = .29, SD = .45) and post-test (M = .38, SD = .49); t(196) = -3.37, p = .001 assessment. The only question that did not show significant changes in score between pre and post-tests was the question about how scientists share their findings. Implications for this result will be shared in the discussion section and provide an opportunity for educators to further elucidate the process of scientific inquiry and discovery and for designers and developers to consider mechanics that better elaborate on these topics.

Grade level differences in pre-post assessment score

In order to determine which of the question items contributed to the significant difference in scores by grade level, a set of paired t-tests was conducted by grade level (Table 4). For sixth grade only participants, all of the changes in means for the questions (from pre- to post-game) are significant except for the seventh question ("How do the environmental factors you listed above affect cone snails?"). For seventh grade participants, all of the changes in means for the questions (from pre- to post-game) are significant except for the seventh question ("How do the environmental factors you listed above affect cone snails?"). For eighth grade participants only, all of the changes in means for the questions (from pre- to post-game) are significant except for the fourth and fifth questions ("What are three ways that scientists share their findings?" and "Why do scientists study cone snails?")

	Mean Pre-Test	SD	Mean Post-Test	SD	*N*
6TH GRADE STUDENTS					
Venom of cone snails	0.13	0.34	0.74**	0.44	31
Cone snail prey	0.00	0.00	0.59**	0.39	31
Cone snail predators	0.00	0.00	0.39**	0.50	31
Science research methods	0.16	0.29	0.34*	0.38	31
Cone snail science	0.00	0.00	0.19*	0.40	31
Environmental factors	0.03	0.09	0.10*	0.16	31
How factors impact snails	0.35	0.49	0.39	0.50	31
Total Score	0.32	0.44	2.33**	1.38	31
7TH GRADE STUDENTS					
Venom of cone snails	0.22	0.42	0.58**	0.50	78
Cone snail prey	0.00	0.00	0.51**	0.43	78
Cone snail predators	0.01	0.11	0.35**	0.48	78
Science research methods	0.12	0.22	0.19*	0.28	78
Cone snail science	0.01	0.11	0.28**	0.45	78
Environmental factors	0.05	0.13	0.11*	0.17	78
How factors impact snails	0.50	0.50	0.50	0.50	78
Total Score	0.41	0.56	2.01**	1.44	78
8TH GRADE STUDENTS					
Venom of cone snails	0.13	0.33	0.67**	0.47	87
Cone snail prey	0.01	0.11	0.40**	0.40	88
Cone snail predators	0.02	0.15	0.14*	0.35	88
Science research methods	0.66	0.48	0.60	0.49	88
Cone snail science	0.08	0.27	0.10	0.30	88
Environmental factors	0.01	0.11	0.40**	0.49	88
How factors impact snails	0.08	0.27	0.27**	0.45	88
Total Score	0.98	0.82	2.57**	1.56	88

* $p < .01$; ** $p = .000$

Table 4. Paired t-test mean scores by grade and question type

Gender differences in pre-post assessment score

While there was no significant main effect of overall score by gender, researchers were curious to see if any differences in gender emerged when looking at the change in scores between pre- and post-tests. A set of paired t-tests were conducted to compare differences in mean scores in pre- and post-assessment by student gender (Table 5). Results indicate that for female students, significant gains were made across each question except

for the fourth question ("What are three ways that scientists share their findings?"). For male students, significant gains were made between pre- and post-assessments for each question except question seven ("How do the environmental factors you listed above affect cone snails?").

	Mean Pre-Test	SD	Mean Post-Test	SD	*N*
FEMALE STUDENTS					
Venom of cone snails	0.15	0.36	0.65**	0.48	136
Cone snail prey	0.01	0.09	0.43**	0.41	137
Cone snail predators	0.02	0.15	0.18**	0.39	137
Science research methods	0.49	0.48	0.47	0.48	135
Cone snail science	0.05	0.22	0.15*	0.35	137
Environmental factors	0.02	0.11	0.29**	0.43	137
How factors impact snails	0.23	0.42	0.37**	0.48	137
Total Score	0.78	0.77	2.34**	1.52	137
MALE STUDENTS					
Venom of cone snails	0.20	0.40	0.63**	0.49	60
Cone snail prey	0.00	0.00	0.56**	0.42	60
Cone snail predators	0.00	0.00	0.43**	0.50	60
Science research methods	0.09	0.18	0.23**	0.29	60
Cone snail science	0.02	0.13	0.28**	0.45	60
Environmental factors	0.05	0.12	0.11*	0.16	60
How factors impact snails	0.42	0.50	0.42	0.50	60
Total Score	0.35	0.55	2.25**	1.45	60

* $p < .01$; ** $p = .000$

Table 5. Paired t-test mean scores by student gender and question type

Student perception of self as scientist

Gains in science knowledge following game play demonstrate the potential of games as a tool for learning. Researchers were also interested in understanding student perceptions of themselves as scientists. Specifically, researchers were curious to discover if students' beliefs about becoming scientists are related to grade level or gender.

At the end of the post assessment students were asked two questions: (1) could you see yourself as a scientist, and (2) why or why not? Only 6th- and

7th-grade students responded to this inquiry as a result of timing yielding a total of 86 students responses. Overall 43% of students said that that yes, they could see themselves as scientists while 57% responded that no, they could not see themselves as a scientist. Of those stating they could not see themselves as scientists 67% were male students and 33%were female students (Table 6).

Two separate analyses of variance (ANOVA) were conducted to determine if student responses to 'Could you see yourself as a scientist' varied as a factor of grade or gender. As Table 6 shows, while student responses did not vary significantly by grade level, student responses did yield significant variation as a result of gender, $F(1, 84) = 5.18$, $p = .03$, where female students more often indicated that they could see themselves as a scientist.

	Yes	No	*N*	M	SD
Female Students	21	16	37	1.43	.50
6th Grade	8	6	14	1.42	.51
7th Grade	13	10	23	1.43	.51
Male Students	16	33	49	1.67	.47
6th Grade	2	10	12	1.83	.39
7th Grade	14	23	37	1.62	.49
Total	37	49	86	1.57	.50

Table 6. Could you see yourself as a scientist?

DISCUSSION & ANALYSIS

For all groups, across gender and grade, STEM understanding around snails and other content related to the *Assassins of the Sea* game increased after game play. In terms of qualitative feedback from students, they were asked to identify the salient aspects of the game and provided several categories of responses including having a better grasp of predator-prey relationships, spurring curiosity about other organisms, and seeing themselves as scientists. Although the post-game assessment increased in

accuracy after the game was played, we cannot say that the game itself was the reason as we do not have a proper control condition. Other limitations of the study are that only 6th- and 7th-grade students were asked to respond to the open-ended questions about themselves as scientists.

We looked at self-efficacy and STEM career interest and identity by asking the participants if they see themselves as a scientist. Although participants were split between seeing and not seeing themselves as a scientist, reasons for or against this varied greatly. Females were significantly more likely to state that they saw themselves as a scientist. For instance, those who had higher STEM self-efficacy and saw themselves as scientists said things like, "I like to learn new things," "I always have questions," "I am very curious," and "I like to experiment." Those that had lower self-efficacy around STEM and did not see themselves as a scientist said things like, "I think it's boring," "It's too much work," "it doesn't seem fun," and "I don't think I'm skilled enough to be a scientist." Additionally, 20 participants who had a higher mean change score (3 or above) on their post-game assessment said they wanted to be a scientist (20/35 or 57% of those who said they wanted to be a scientist), whereas only 10 of the participants who had a higher mean change score said that they wanted to be a scientist (10/46 or 22% of those who did not want to be a scientist), suggesting that perhaps there is a relationship between comprehension (higher scores) and self-efficacy around STEM, and perhaps a game can help to support this.

There are a number of gaps in this and similar research that should continue to be explored. One, how are self-efficacy, identity, curiosity, and SEL skills around STEM related to increased STEM knowledge? Does greater STEM knowledge increase self-efficacy, or does self-efficacy increase knowledge, or is it both? We need to understand further how these types of skills and learning support each other, and, we need to understand how games can specifically support both of these types of skills and learning, as they seem to be interrelated. Second, what are the specific design principles and contexts for games that further enable the support of SEL and STEM learning? Are there specific ways that we can design games to better support these skills, such as through problem-based learning, teacher/mentor involvement, and generating a sense of purpose. Third, we

did not find gender differences in how the students performed on the post-game assessment, but we found that more females identified as wanting to be a scientist than males. Are there gender differences in how a game may support self-efficacy around STEM? Are there specific ways that games can support more self-efficacy around STEM for particular populations or marginalized populations? We did not measure self-efficacy before and after the game, or compare it to a control condition, and it would be useful, moving forward, to add this into the analysis to better understand how this particular game may support it.

Based on this study, our literature review, and our observations of the use of *Assassins of the Sea* in the middle school classrooms, we make five initial recommendations for designing and using games for STEM:

Balance. Designers and educators may want to consider how to balance the need for STEM accuracy and learning STEM-related knowledge, processes, and facts, with encouraging STEM curiosity, identity, self-efficacy, and other social and emotional skills. More research is needed to understand how this balance is best achieved through games and game design, with consideration to classroom and other learning contexts.

Meaning. The design of the game should contribute to the sense of purpose for the player. Goals, obstacles, problems, and possible solutions posed by the game should be meaningful to the player, both in terms of the game's play, and to the player more personally. The game's design should help the player feel a sense of purpose—such that they need to solve a STEM-related problem, but also that their actions and contributions personally matter.

Role-play. While the game does not need to be a role-playing game, it may be useful to incorporate interactions with STEM knowledge in the game, with an exploration and understanding of the role of a STEM researcher/practitioner. Players should understand the processes and mechanisms behind the STEM problems they are trying to solve, while embodying what scientists and engineers do. The game could enable the players to authentically act in these roles, use related tools, or address real-world data, so that players can more easily see themselves as a scientist, as this may also connect to their learning effectiveness.

Assessment. When assessing the game, researchers and educators should consider assessing both STEM knowledge and learning along with STEM self-efficacy and curiosity, such as their willingness to participate in science or their interest in a career in STEM. The SEL-related skills need to be seen as just as worthy to investigate as the STEM learning and knowledge building. Game designers may even want to build these assessments through the game's play itself, and should consider how to assess STEM SEL skills through a game's play.

Scaffolds. Consideration for scaffolds that would support educators in extending student inquiry outside game play would be beneficial to students, designers, and developers. Providing support for educators to help unpack complex concepts or narratives outside gameplay may increase students' self-efficacy in science and improve their strategies during game play. Identifying the strategies that best support student approaches to learning can help designers and developers select mechanics that are most useful for teaching complex content.

CONCLUSION

In this paper, we explored how games can support STEM learning, and the role of SEL such as STEM self-efficacy, identity, and curiosity in enhancing learning. We conducted a study of *Assassins of the Sea*, a deck-building card game about killer marine snails, where participants conduct research on their snail's peptides to create in-game cures and compete against other players. We looked at 178 participants in two schools across three grades (6th, 7th and 8th grade), and found that on the whole, STEM knowledge of marine snails, and other relevant learning from the game, significantly increased between the pre- and post-game assessments. A portion of the players (N = 109) were also assessed qualitatively on their scientific self-efficacy, STEM identity and interest in being a scientist. We found that the responses varied, but a higher proportion of females had an interest in being a scientist, and those whose scores changed more substantially from pre- to post- also demonstrated a higher interest in being a scientist. A future study should include a control condition and questions about self-efficacy both pre- and post-game to further parse out the effect of the game on these measures.

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APPENDIX I.: *ANALYSIS OF ASSASSINS OF THE SEA, USING THE CHECKLIST CREATED BY DUNLAP AND RIVERS (2018).*

Component	*Y or N*
Designed for a teen audience	Y
Integrates evidence-based SEL content accurately	N
Is a complex system comprised of interesting, meaningful choices (complexity)	Y
Players are active, influential agents within the game space (autonomy & agency)	Y
Players start with basic mechanics or knowledge which scale in difficulty and complexity in response to actions	Y
Skills are practiced and revisited across multiple contexts (iteration)	Y
Social and emotional content is embedded within gameplay via mechanics, narrative, cut scenes, etc. (integration)	Y
Challenges faced can provide opportunities for social and emotional growth experiences within and around the game (identity)	Y
Provides opportunities to connect and learn from more experienced players (mastery)	Y
Supports and encourages sharing of personal accomplishments, performances (supported sharing)	Y
Facilitates social interaction and meaningful relationships (connection)	Y
Provides an environment where the process of learning from mistakes is valued and supported by the group (productive failure)	Y
Feedback is timely, consistent, constructive, and accurate (constructive feedback)	Y

Playing Against Abuse

Effects of Procedural and Narrative Persuasive Games

RUUD S. JACOBS PHD, JEROEN JANSZ PHD, AND JULIA KNEER PHD

ABSTRACT

Persuasive games—games that intend to change attitudes in players—employ numerous types of persuasive tactics; the individual contributions of such tactics to the effectiveness of these games as a full experience have not yet been tested. In this study we examine two existing persuasive games about teen dating violence by performing a controlled experiment on effects on attitudes towards abusive relationships. We selected these games on the basis of their relative focus on narrative or procedural arguments (i.e., mirroring real-world processes through in-game systems). Participants (N = 262) were drawn from a mixed sample of university and senior secondary school students who, with a mean age of 19 years, were slightly older than the game's target audiences. Results indicated that the games affected some of the attitudes they were intended to, but that the effects of the narrative and procedural games were not differentiated. Character and cognitive identification (with the game's protagonists and procedural rhetoric) differed between games, but negatively predicted attitude change. We describe conclusions about how game developers may comfortably explore multiple designs without fear of hampering effects.

INTRODUCTION

Games are a new frontier in persuasive media. Barring a handful of recent

efforts (e.g., Gerling, Mandryk, Birk, Miller, & Orji, 2014; Jacobs, 2018; Peng, Lee, & Heeter, 2010; Ruggiero, 2015; Soekarjo & van Oostendorp, 2015), how games may persuade players using rhetoric embedded in their design remains largely unexplained. Although a great deal of research has been performed into unintended effects of games (Elson & Ferguson, 2014) and into (adver)games that seek to improve brand or product opinions through mechanisms of affect transfer (Waiguny, Nelson, & Marko, 2013), research into the effects of games that include rhetorical arguments is lacking. However, these *persuasive games*—games that have been designed primarily to affect player attitudes or behaviors on real-world topics—do not operate the same way as other persuasive communications. Chiefly, their interactivity allows for "procedural rhetoric," the embedding of arguments into the systems and rules governing play (Bogost, 2007). Players *playing* with a game's (partial) simulation of real-world phenomena and testing its boundaries can enable a deeper understanding of why certain issues exist and how to deal with them.

In games, procedural rhetoric joins the abundance of persuasive dimensions found in other non-interactive media (de la Hera Conde-Pumpido, 2015); games can persuade through text, visuals, sounds, and even tactile sensations. They can also string together events into narratives that form distinct persuasive actuators (Slater, 2002). Using an experimental study design, we attempt to disentangle the persuasive impacts of procedural rhetoric and narratives in games to provide insight into the unique affordances of this medium and help determine its place in persuasive communication.

The research question guiding this study was: How do persuasive games with a focus on either narrative or procedural rhetoric lead to different persuasive outcomes? To answer this question, a controlled experiment was performed, employing two published persuasive games as stimulus material: *Another Chance* (Another Kind, 2015) and *Power and Control* (Sain, 2011). These games were developed to meet the same criteria with regards to their message; they were both entries in the annual Life.Love. Game Design Challenge issued by the Jennifer Ann's Group, a 501(c)(3) nonprofit charity group dedicated to preventing teen dating violence (Crecente, 2014; Jennifer Ann's Group, 2015). This article describes the differences between

two persuasive games with a shared prosocial subject, before outlining the study's methods and results.

Narratives and Procedural Rhetoric

The primary ways games deliver messages may be found in their procedural rhetoric or in their narratives. Games' procedural arguments focus on simulating specific real-world processes relevant to the game's topic. By engaging with game systems, players can draw their own conclusions about real-world issues. Games may take players through narratives that are either completely linear or that branch depending on player actions as they progress through the game, although both types of narrative are valid routes to persuasion. This study compares a narrative-focused game to a game utilizing procedural rhetoric related to dating violence, and a control game *not* about dating violence. Although the more procedurally-focused game in our comparison includes a series of events in a brief narrative, its persuasive heft is predicated on how it leverages the gameplay to have players *experience* facets of an abusive relationship.

Narrative and procedural persuasive elements are not mutually exclusive, however, the two are not inextricably linked either. Persuasive games such as *Nova Alea* (Molleindustria, 2016), marry procedural rhetoric to narratives, where choices cause players to directly engage with the systems at play while also feeding into longer-term goals and events for the game's protagonists. *My Cotton Picking Life* (Rawlings, 2012) on the other hand, offers players scant leeway as they embody a child laborer picking cotton in Uzbekistan, operating within the endless futility of manual slave labor (Jacobs, 2018). Conversely, *Another Chance*, included in this study, employs systems that only tangentially relate to the issue of teen dating violence. Rather, the game relies primarily on its narrative to fuel its persuasive effect. Because narrative and the interactive systems of a game can be dissociated, differences in their effects should be researched for a more complete understanding of how persuasive games persuade their players.

Persuasive Narrative Mechanisms. Narratives are known to exert persuasive effects in media besides games (Slater, 2002). A theory that supports narrative persuasion is social learning (Bandura, 1986), since most game

narratives follow a human or anthropomorphized protagonist. In games where narratives follow linear paths and players' actions can only progress (rather than direct) the storyline, this protagonist could act as a model for the player by way of a parasocial relationship (Papa et al., 2000). The narrative creates an arc for this main character (Slater, 2002), showing them as starting off with the same attitudes as those *presumably* held by the player. The arc takes this character through several stages of change (Prochaska, DiClemente, & Norcross, 1992), after which they end up with the attitudes the game intends to instill in the player. In this way, attitudes may change through game-play by way of a mechanism that is related not to a game's systems but to its characters. For this reason, attitude change as a result of narrative persuasion would be predicted by the degree to which players identify with the game's protagonist, as evidenced in film and television (Slater, 2002) and interactive narratives (Steinemann et al., 2017).

Procedural Rhetoric in Persuasive Games. While game narratives have their counterparts in other media from which to theorize their effectiveness in persuasion, no such analogy exists for procedural rhetoric. Because it relies on the interaction of player and game systems, "Procedural Rhetoric" is a rhetorical form unique to games (Bogost, 2007). Indeed, persuasive games have not been differentiated from previous pervasive media forms in terms of influence on attitude change, based on content alone (Waiguny et al., 2013). Peng et al. (2010) however, compare the effect of interactivity with a game to its narrative by removing interactivity from the experience of two conditions of their study. In their study, participants either read a text, played a persuasive game, or watched recorded gameplay footage of the game. Their results indicated that not allowing viewers to interact with the game and work out its rules through play had a negative effect on their resulting attitude change. Game watchers did not differ significantly from text readers, though game players were affected significantly more than both other groups (Peng et al., 2010).

Because not every interaction in games is necessarily a component of their procedural rhetoric, focusing vaguely on "interactivity" does not offer conclusive insights into the impact of more intentional parts of a game. Additional insight is needed into the effects games have when procedural rhetoric is explicitly present or absent. This study gauges players'

recognition of the similarities between game systems and the real-world processes they mimic as a psychological antecedent of attitude change through procedural rhetoric. Such a measurement hews to the cognitive identification found in multiple identification theory (Williams & Williams, 2007), where players "identify the simulation with reality and see its principles as valid in real life" (p. 5).

Combating Teen Dating Violence with Games

Different kinds of interventions have been implemented to curb issues of physical, sexual, and emotional violence in adolescent relationships (De La Rue, Polanin, Espelage, & Pigott, 2016). This issue is educational, which requires recurring emphasis in and out of schools. The primary goal of Jennifer Ann's group (JAG) is to spread awareness of teen dating violence and share knowledge (with victims and bystanders) about how to prevent it from happening. JAG issues the annual Life.Love. Game Design Challenge (Jennifer Ann's Group, 2015) for games meeting the following criteria: discussing the topic of teen dating violence and the warning signs of an abusive relationship, and presenting options for bystanders and victims to take action against it, *without* allowing for violent gameplay (Crecente, 2014). Developers are given the freedom to create any kind of game within these constraints, leading to an impressively varied group of games. The games are shared digitally on the JAG game repository and include diverse genres (Jennifer Ann's Group, n.d.). Entries to this challenge are judged by a panel of game developers and researchers actively working with the topic of teen dating violence or who have previously worked on the design of serious games. Games published on the JAG website have therefore undergone a sort of peer-review to ensure topical focus, and improve overall quality (D. Crecente, personal communication, August 12, 2015). This set presents a unique opportunity for investigating games made by a diverse group of developers but highly similar in the message they intend to convey. For the current study, two games were selected from this set based on their procedural or narrative elements.

Narrative-led persuasive game. *Another Chance* is the 2015 winner of the Life.Love. Game Design Challenge. It is an action role-playing game (RPG) that is viewed from a top-down perspective. The visual style is reminiscent

of 16-bit Japanese RPGs such as *Secret of Mana*. The game's narrative involves a woman dreaming that she is in a videogame. Though she is confused at first, she soon learns from conversations with family and friends that she was being abused and ultimately realizes that she has been unconscious throughout the game. The protagonist had been hospitalized after being assaulted when she tried to break up with her partner. The gameplay consists of walking around the game world and speaking to other characters.

The protagonist's initial confusion reflects a precontemplation stage of attitude change (Prochaska et al., 1992). For the majority of the game, the character's objective is to obtain several keys to free her ex-partner from prison. After hearing others' views, she becomes convinced that her partner is not behaving correctly, resulting in her rejecting him, and no longer blaming herself for his wrongdoings. The narrative *models* the protagonist's mental journey to acknowledging and ending her abusive relationship. Action elements imbue the game with a light procedural argument: players gather courage (in the form of in-game collectibles) which they use to shout "no!" to fend off ghost-like hostile characters trying to drag the protagonist away. Apart from this gameplay dynamic, the gameplay and systems do not mimic the processes in abusive relationship, meaning the persuasive influence of the game depends primarily on its narrative elements.

Procedural persuasive game. *Power and Control* is a game that deals with the topic of teen dating violence in a novel way. The game has no visual components beyond a pink background on which text is superimposed. The game's two layers of audio are a soft background score and a fully voiced young male boyfriend character. The player uses the mouse cursor to 'touch' words on screen, which may represent physical objects, actions, or the otherwise silent protagonist's thoughts and feelings. The game consists of a sequence of interactions with the boyfriend character that indicate he is acting abusively towards the protagonist. This is made clear by his efforts to control how the protagonist dresses and even by forcing her into abstractly represented sexual actions. The game is made to feel oppressive the boyfriend is constantly speaking, becoming more and more hostile as the game progresses.

Power and Control uses procedural rhetoric by putting players in the shoes of the victim of abuse while the abuse is taking place. The player is repeatedly asked to approach or avoid certain words, and has to maneuver (physically, by way of the mouse cursor) around the boyfriend. The only course of action available to players is to weather the storm of abuse. They are forced to comply with the abuser's demands to progress through most of the game. The protagonist's thoughts are visualized on screen independently of the voiced boyfriend character, indicating she is trying to ignore his behavior. Although this means that there is a small narrative arc in the game where the protagonist is coming to terms with her situation, the player is always in control of this process. Players can ultimately choose to stay in the relationship or to leave the abuser. The narrative is not emphasized to the degree it is in *Another Chance*.

HYPOTHESES

By looking at *Another Chance* and *Power and Control*, this study tests differing effects of narrative and procedural persuasive elements in games. We attempt to demonstrate antecedents of attitude change originating from both kinds of argument. The following are our hypotheses generated from previous results and literature:

Hypothesis 1: Both the narrative-focused game (*Another Chance*) and the procedurally-focused game (*Power and Control*) change attitudes to the issue of teen dating violence compared to a control game, *Samorost 2* (Amanita Design, 2005).

Hypothesis 2: There is a difference in attitude change resulting from the narrative-led and procedural game.[1]

Given a lack of sufficient previous data, We do not specify which of the two games will show greater effects. As stated previously, procedural rhetoric has not been empirically validated and narrative persuasion has only been investigated in other media (Slater, 2002).

Hypothesis 3: Attitude change as a result of the narrative-led game can be predicted from identification with the game's protagonist.

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Hypothesis 4: Attitude change as a result of the procedural game can be predicted from cognitive identification with the game's systems (i.e., an acknowledgment that they reflect real-world processes).

METHODS

Sample

Two samples were drawn for this study, reaching a total of 262 participants. Because the target audience of both of the persuasive games is teenagers, the first sample was drawn from the final three grades of three Dutch secondary schools. This first sample yielded 147 participants aged 15 to 19 (M = 16.3, SD = .74), with 68.7% of the participants identifying as male. The schools communicated the topic of the study as "serious gaming." The second sample was drawn from the mixed Dutch and international student body from a Dutch university. The call for participants for this sample was described as being about "interactive experiences of pro-social topics." The 115 university students were comparatively older than those in the initial sample, ranging between 18 and 32 years of age (M: 22.5, SD: 22.87), with 60.9% participants identifying as female. The average age across all participants was 19.0 years (SD: 3.67), with a slight majority identifying as male (55.7%).

Participants were randomly assigned to play *Power and Control* (n = 99), *Another Chance* (n = 102), or the control game (n = 61) that was unrelated to dating violence. To ensure sufficient statistical power for a comparison between the two persuasive games (rather than between all groups), the randomization procedure was weighted towards the persuasive game groups with a ratio of 2 (narrative): 2 (procedural): 1 (control). Since the two treatment conditions were expected to differ more from the control condition than each other, the uneven distribution was planned to enable the experiment to test for moderate differences to the control while discerning smaller effects between treatment conditions. The small deviation of the final sample from the intended 2:2:1 distribution was due to a group-based testing protocol detailed below. The distribution of

participants of both genders was equal across conditions ($X^2(2) = .50$, $p = .778$).

Although the games were only playable in English, the instructions for participants and measurements were all available in English and Dutch. All secondary school students except for one completed the study in Dutch, while 32.2% of university students preferred Dutch over English, reflective of the international make-up of the university's student body. All participants from the university sample were financially compensated. One of three groups (40.1% of the full sample) of secondary school students received a similar reward upon completion of the study, while the others participated during school hours and were not compensated.

Stimuli

Another Chance served as the narrative-oriented game stimulus and *Power and Control* as the procedural game stimulus. The freely available first chapter of *Samorost 2*—an online Flash-based point and click game—was used for the study's control condition. In *Samorost 2*, players guide a small anthropomorphic creature to rescue its pet from a pair of alien abductors. This game was chosen for the control condition because its presentation, gameplay, and storyline were unrelated to the topic of teen dating violence and its gameplay was accessible enough that participants could proceed through it without getting stuck. The game did however serve to engage all players, keeping them focused on play for the game's duration. In debriefing sessions, many participants described actively considering the game's link to the survey, for instance by suggesting the protagonist's mission to save its pet as a metaphor for abusive relationships. Few respondents rejected this idea initially, which serves as an indicator that participants were looking for meaning in the game. The game therefore could be said to have acted as a placebo for many respondents who felt the game did attempt to discuss this topic in some obscure way.

The games differed in the time it took participants to complete them: *Power and Control* had, on average, the shortest play time ($M = 13.1$ minutes, $SD = 4.01$). *Another Chance* took the most time to finish ($M = 39.5$ minutes, $SD = 7.60$), with *Samorost 2* in between ($M = 33.8$ minutes, $SD = 7.13$). All play time

differences between groups were significant and large ($F(2, 255) = 450.5$, $p < .001$, partial-$\eta^2 = .78$).

Procedure

Although the procedure differed slightly for the two samples drawn for this study, all participants followed one of three paths through the same online digital questionnaire. Participants were seated in front of a computer with headphones. A short introduction on the procedure of the study was given by the experimenter before the survey was started. After participants provided informed consent, they put on the headphones, clicked a link to go to a game page, and began playing until they completed the game or until they were asked to stop. The games are hosted on their respective publishers' websites. Upon starting the game, participants were given a paper sheet with instructions on how to play the games. The contents of these sheets were based on issues encountered in informal pre-testing. For *Another Chance*, this included the game's controls—with emphasis on how to check the current in-game objective and tips on how to fend off the ghost-like enemies. For *Power and Control*, the sheet explained how the mouse cursor interacted with words and discussed how to complete one specific scene in the game that many players struggle with. The sheet for *Samorost 2* simply explained the way a cursor changes appearance if an object can be interacted with. To avoid issues with difficulty, participants were told during the introduction that they could also ask the experimenter for assistance during play. All sessions were monitored by the same experimenter.

To limit the experiment's time while allowing the greatest number of participants to finish the games, participants were asked to stop playing after 45 minutes if they were not yet close to completion, or they were allowed to continue for slightly longer if they were close to completion. This time-limit allowed 98.0% of players to finish *Power and Control*, 86.3% to finish *Another Chance*, and 68.9% to finish *Samorost 2* during the study.

After completing their game, or the 45-minute time limit elapsed, respondents continued to the online questionnaire, filling in the items comprising the study's measurements. These included questions on game

completion and comprehension, two attitude scales on dating violence, character and cognitive identification scales, game enjoyment questions, a short scale on obtrusiveness of persuasive intent, and demographic items (in this order). The survey closed with an open-ended question allowing for candid comments on the study or the games. After completing the questionnaire, respondents entered a debriefing stage.

The university student participants were tested in a laboratory setting in pairs, separated by a cubicle wall. Debriefing took place individually or in pairs, starting as soon as participants completed the study. Secondary school student participants were tested in different settings. The majority (61.9%) were tested in a classroom with between 12 and 25 participants per session. Within the classrooms, participants were divided across conditions, though care was taken to position them so they could not see other games being played. The remaining 38.1% of secondary school students were tested in groups of four students that were assigned to the same condition.

Debriefing sessions followed a loose structure, though each session started with the experimenter explaining he was not involved with the design of the games in the study and asking for honest opinions. From there, participants' interests were followed in the discussion. Afterwards, the study's design and goals were briefly explained, and the participants were thanked for their participation.

Analysis

All measurement scales used in this study were subjected to principal component analysis with oblique (oblimin) rotation and tested for reliability using Cronbach's alpha before being averaged into scale variables. Hypotheses were tested with multivariate analyses of response variance using planned comparisons and Dunnett or Tukey post-hoc tests (Seltman, 2015) and linear regressions. Indicators of effect size were selected, computed, and interpreted in accordance with Lakens (2013). Power analyses were performed using G*Power version 3.1.9.2. All other analyses were performed using IBM SPSS Statistics version 23.

Measurements

All measurements in this study were taken after the play session. The main measurements consisted of two attitude scales on dating violence and two scales separately gauging character and cognitive identification. These items are listed in Table 1.

Teen dating violence attitudes. To measure attitudes toward the issue of teen dating violence, the Justification of Verbal/Coercive Tactics (JVCT) scale was adapted (Slep, Cascardi, Avery-Leaf, & O'Leary, 2001). This scale consisted of 11 items describing behaviors in relationships. Participants rated behaviors on a five-point scale as admissible or inadmissible separately for both male and female actors. Four items were added, relating to texting and social media, to keep pace with techno-social developments. In total, this created 30 items measuring acceptability of behaviors for men and women. Factor analysis called for the separation of the scale into three subscales. The first measured justification of controlling behaviors on a social level (social control, 12 items, Cronbach's $\alpha = .90$). The second was concerned with justification of jealous behaviors (jealous behavior, 12 items, $\alpha = .89$). The final grouping combined items on angry and violent behaviors (angry behavior, six items, $\alpha = .85$). Higher values on these scales indicate less justification and less acceptance of abusive behaviors.

Table 1: Item list of the scales used in this study.

Justification of Verbal/Coercive Tactics scale	*M* (M)	*SD* (M)	*M* (F)	*SD* (F)
Social Control subscale (12 items, α = .90)				
Keeping him/her from seeing or talking to his/her family	4.69	.64	4.69	.61
Turning his/her family and friends against him/her	4.81	.59	4.82	.48
Keeping him/her from doing things to help himself/herself	4.64	.68	4.62	.75
Using a second phone that the partner does not know about *	4.61	.74	4.62	.71
Demanding to know his/her passwords to social media, e-mail, and other accounts *	4.60	.70	4.60	.72
Sharing or threatening to share sexually explicit pictures of him/her with others *	4.89	.54	4.90	.52
Jealous Behavior subscale (12 items, α = .89)				
Interfering in his/her relationship with family members	3.88	.98	3.88	.98
Being jealous and suspicious of his/her friends	3.76	.90	3.71	.92
Being jealous of other girls/boys	3.28	1.02	3.23	1.03
Checking up on him/her, making him/her say where he/she was	3.63	1.11	3.63	1.08
Accusing him/her of seeing another girl/boy	3.90	.79	3.90	.80
Texting constantly to check up on him/her *	4.21	.80	4.20	.83
Angry Behavior subscale (6 items, α = .85)				
Insulting or swearing at boyfriend/girlfriend	4.07	.88	4.03	.86
Stomping out of the room or house	3.42	.98	3.38	.98
Doing or saying something to spite him/her	3.80	1.13	3.76	1.15
Other attitude and identification scales				
Victim Blaming scale (3 items, α = .82)			M	SD
Most physical violence in dating occurs because a partner asked for it			1.50	.91
If you did something wrong, it is your fault if you get hit			1.39	.81
If you make up after being abused, it won't happen again			1.44	.86
Self-Efficacy in dealing with abusive relationships scale (3 items, α = .72)				
I know how to tell if someone I know is in an abusive relationship *			2.98	1.04
As an outsider I can help if someone I know is in an abusive relationship *			3.47	1.02
I know what to do if someone I know is in an abusive relationship *			3.08	1.08
Recognition of abusive situations/relationships (5 items, α = .68)				
A dating partner who wants to be in charge and make all decisions might become abusive			3.11	1.12
Slamming a door or driving recklessly in a car to scare someone is abusive			3.60	1.17
It can be abusive to yell at someone even if you don't hit them			3.87	1.19
It is possible to be angry or even argue with your dating partner without being abusive			4.35	1.03
People can strongly deny being in an abusive relationship even when they realize that something is not right *			4.18	1.04
Character Identification scale (6 items, α = .85)				
I agreed with the main character's thoughts and what she said *			2.91	1.17
The way the main character reasoned was similar to how I thought about this topic *			2.41	1.09
I recognize myself in the main character			1.87	1.04
The main character is an example to me			1.97	1.09
The main character has characteristics that I would like to have			2.20	1.10
The main character is like me in many ways			1.96	1.01
Cognitive Identification scale (6 items, α = .86)				
This game lets players experience abuse in a safe way *			3.50	1.19
The gameplay in this game shows what it is like to be abused *			2.89	1.26
The way this game works reflects what abuse is like in the real world *			2.77	1.20
This game is meant to be played for its message, not just for fun *			4.00	1.20
The way this game is played makes me think of what it is like to be abused *			2.92	1.39
The way this game is played shows how abusive relationships can work *			3.15	1.32

*Note: Means and standard deviations are shown for each item and scale, and Cronbach's α is shown for relevant scales. Items for the JVCT are posed twice (M for male/F for female perpetrator). *Item developed and included specifically for this study.*

Table 1: Item list of the scales used in this study.

Separately, wider attitudes towards dating violence were measured using a nine-item, five-point Likert scale developed by Macgowan (1997). These

questions were also complemented with seven new items. Factor analysis again supported a division into three subscales. The first related to victim agency and culpability in abusive relationships (victim blaming, three items, α = .82), while the second was about self-efficacy with regards to handling abusive situations for oneself and friends (self-efficacy, α = three items, .72), and the third gauged the self-reported ability of respondents to recognize abusive relationships (recognition, five items, α = .68). Higher values on these scales indicate more compassion with victims, higher self-efficacy, and greater sensitivity in abuse recognition, respectively.

Character and cognitive identification. To support the contention that the games' relative emphasis on either narrative or procedural persuasion may cause differences in attitude found, two indicator scales were used. Identification with the games' protagonists was used as an indicator for narrative persuasion; those who feel closer to their character will be engaged in a game's story more strongly. This nine-item scale is a combination of character identification measures in previous literature (Van Looy, Courtois, De Vocht, & De Marez, 2012; van Reijmersdal, Jansz, Peters, & van Noort, 2013). Items were adapted to fit the games used in our conditions. Because no known previous measure existed for the perceived similarity of game- and real-world processes, six items were developed to measure this construct. The items were informed by the concept of cognitive identification described by Williams and Williams (2007). Factor and reliability analyses supported the division of the two types of identification, leading to two scales: six items for character identification (α = .85) and six items for cognitive identification (α =.86).

RESULTS

Hypothesis 1 predicted that both types of persuasive game would affect attitudes about the issue of teen dating violence more than the control game. This hypothesis was tested using a multivariate ANOVA with the six dating violence attitude scales with planned contrasts between both of the persuasive game conditions and the control condition, ending with post-hoc Dunnett's tests. The overall ANOVA result was significant with a medium effect size (Wilk's Λ= .88, $F(12,508) = 2.78$, $p = .001$, *partial*-η^2 = .06). Looking at the individual attitude scales, the conditions were found

to differ significantly (though with small effects) on justification of angry and violent behaviors ($F(2,259) = 5.40$, $p = .005$, *partial*-$\eta^2 = .04$) and on self-efficacy with regards to dealing with abusive relationships ($F(2,259) = 4.17$, $p = .017$, *partial*-$\eta^2 = .03$). The other four attitude scales did not show significant overall differences (justification of social control: $F(2,259) = 0.37$, justification of jealous behavior: $F(2,259) = 2.31$, victim blaming: $F(2,259) = 1.45$, and recognition of abusive behaviors: $F(2,259) = 1.10$, ps > .05). Planned comparisons were drawn for justification of angry behavior and self-efficacy in dealing with abusive relationships. *Another Chance*'s (*AC*) players held different attitudes from those who played *Samorost 2* (*S2*) for both justification of angry behavior (*AC*: $M = 3.82$, $SD = .78$, *S2*: $M = 3.47$, $SD = .78$, $p = .004$, Hedges' G_s=.45) and self-efficacy (*AC*: $M = 3.14$, $SD = .80$, *S2*: $M = 3.43$, $SD = .80$, $p = .029$, Hedges' G_s= .36). *Power and Control* (*P&C*) fared similarly, yielding different attitudes from the control condition on justification of angry behavior (*P&C*: $M = 3.84$, $SD = .68$, $p = .003$, Hedges' G_s = .51) as well as self-efficacy (*P&C*: $M = 3.05$, $SD = .87$, $p = .005$, Hedges' G_s = .45). Apart from these effects, the post-hoc comparison between *Another Chance* and the control group also returned a significant difference on attitudes on the justification of jealous behaviors (*AC*: $M = 3.87$, $SD = .66$, *S2*: $M = 3.66$, $SD = .61$, $p = .039$, Hedges' $G_s = .33$). Closer inspections of the average attitude scores of the groups, however, show that players in the control group held the highest scores on self-efficacy in dealing with abusive relationships, compared to both treatment groups. The scaling of these items indicates that players of either persuasive game felt *less* sure of their ability to deal with abusive relationships. Because the attitudes for two scales were different from the control condition for both persuasive games and *Another Chance* also affected attitudes on a third scale, the first hypothesis is tentatively accepted. Though effects are small and not ubiquitous, the games can be said to reduce acceptance of angry behaviors as well as the self-efficacy of dealing with abusive situations.

Hypothesis 2 predicted attitude change to be different for both persuasive games because of the differences in their design. A multivariate ANOVA was performed on the two persuasive game conditions (excluding the control group) with the six dating violence scales as dependent variables. The overall result was not significant (Wilk's $\Lambda = .95$, $F(6,194)= 1.81$), with none of the individual variables showing significant differences (social

control: $F(1,199) = .57$, jealous behavior: $F(1,199) = 2.28$, angry behavior: $F(1,199) = .03$, victim blaming: $F(1,199) = .29$, self-efficacy: $F(1,199) = .54$, recognition: $F(1,199) = 2.08$; $ps > .05$). Hypothesis 2 was therefore rejected; there were no differences in the effects *Another Chance* and *Power and Control* had on attitudes towards dating violence. The power this study achieved in discerning the current analysis' very small effect (f2(V)=.06) was .68.

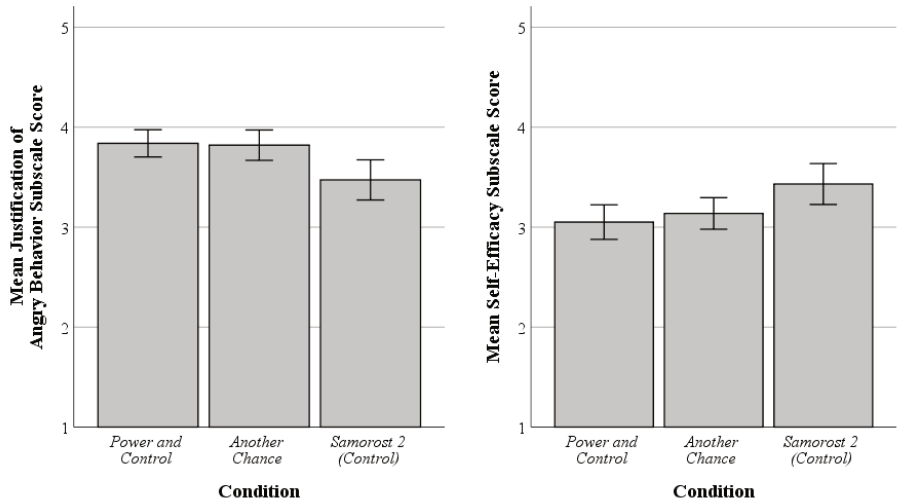

Figure 1: The differences in means between the three conditions for the justification of angry behavior subscale and the self-efficacy subscale tested for hypotheses 1 and 2. Both scales had five-point likert-type response options. 95% CIs are included for each condition.

The third hypothesis predicted that attitude change as a result of the narrative of *Another Chance* would be the result of identification with the game's protagonist (character identification). While *AC* did show higher character identification in a one-way ANOVA than *P&C* with a large effect size ($F(2,259) = 40.52$, $p < .001$, *partial*-$\eta^2 = .24$), the relationship of this identification with attitude change was the inverse of that expected: in separate linear regressions, three of the six outcome scales were negatively predicted by character identification for *AC* players. These were social control ($F(1,100) = 11.07$, $p = .001$, $\beta = -.32$, $R^2 = .10$), jealous behavior ($F(1,100) = 6.44$, $p = .013$, $\beta = -.25$, $R^2 = .06$), and victim blaming ($F(1,100)$

= 4.78, p = .031, β = -.21, R^2 = .05). This effect was not found for angry behavior (F(1,100) = 1.32), self-efficacy (F(1,100) = 0.86), or recognition (F(1,100) = .35). Although effects on justification of behaviors were limited to *AC*, character identification also negatively predicted victim blaming among *P&C* players (F(1, 97) = 9.76, p = .002, β = -.30, R^2 = .09). This means that despite the positive influence of *AC* and *P&C* on justification of jealous behavior, players who identified more with the protagonists of either game subsequently reported greater justification of abusive behaviors (in *AC*) and increased victim blaming. Because this effect runs counter to expectations, H3 is rejected.

Finally, hypothesis 4 predicted a positive influence of likening *P&C*'s gameplay to real-world abuse processes (cognitive identification) on subsequent attitudes. A one-way ANOVA showed cognitive identification was higher for *P&C* than for *S2* (F(2,259) = 94.64, p < .001, *partial*-η^2 = .42, M_{diff} = 1.50, p<.001), though *P&C* and *AC* did not differ (M_{diff} = .01, p = .995). Four of the six attitude scale scores were unrelated to cognitive identification among *P&C* players; social control (F(1,97) = .13), jealous behavior (F(1,97) = .82), angry behavior (F(1,97) = 0.37), and victim blaming (F(1,97) = 0.32). Self-efficacy, however, was *positively* predicted for these players (F(1,97) = 4.99, p = .028, β = .22, R^2 = .05). Recognition of abusive relationships was also positively predicted (F(1,97) = 26.33, p < .001, β = .46, R^2 = .21). Cognitive identification was not related to attitudes for the other two groups, although *AC*'s players show a borderline significant positive prediction (p = .073, β = .18) of self-efficacy similar to *P&C*'s. Across both persuasive games, character and cognitive identification were positively (though weakly) correlated (r = .23, N = 201, p = .001). Again, these results run counter to the difference in attitudes between players of *P&C* and the control group, as that comparison showed lower self-efficacy among *P&C*'s players. This pattern does not allow us to conclude cognitive identification was responsible for the effects of *P&C*, and so we reject H4.

DISCUSSION

Although not all attitudes were affected, both persuasive games showed a clear difference with the control game in the attitudes their respective players held afterwards. Primarily, players of both *Another* Chance and

Power and Control reported being less accepting of angry behaviors in relationships, while *Another Chance* also reduced justification of jealous behaviors. These results show a small but significant effect in strengthening attitudes of players against relationship abuse. Although the results found on the self-efficacy in dealing with relationship abuse seem counter-intuitive—as the persuasive games lowered rather than increased self-efficacy relative to those in the control condition—they could indicate increased awareness of the issue of dating violence. Participants had an increased sense that they would not know what to do if they or someone they knew found themselves in an abusive relationship. It could be beneficial for players if this realization spurred them on to educate and train themselves to prevent abusive situations from occurring. On the other hand, it could also indicate a sense of helplessness. In this case the games' effect would be negative, reducing players' confidence and increasing apprehension towards relationships in general. Determining the precise significance of this reduced self-efficacy to players of these games is beyond the scope of this current study. These uncertain effects could be because neither game was designed by making use of an evidence-based design strategy (e.g., like DeSmet et al., 2016), making it difficult to ground specific design choices in validated persuasive strategies. Although evidence-based persuasive games are rare, future research should continue to strive to link game dynamics and texts to previously successful strategies found in other media.

The sizes of effects found while testing the first hypothesis offer a possible explanation why the second hypothesis, predicting a difference in attitude change as a result of either narrative or procedural elements, was not retained. Because the impact on attitudes directly after play was small, it is likely that further differentiating two successful persuasive games would require greater granularity in effect measures than observed in this study. The difference between the games' persuasive power in the short term could therefore be said to be trivial despite their divergent designs. The current findings do show that persuasive games do not necessarily have to be long to be immediately effective; the two games did not differ in effects despite *Power and Control*'s mean playtime being a third of that of *Another Chance*. There can of course be more to the impact of a persuasive game

than its immediate attitudinal influence, such as the sleeper effect noted by Ruggiero (2015), but this is beyond the scope of this study.

In testing the third hypothesis, we found negative predictive effects of character identification on justification of controlling and jealous behaviors as well as victim blaming. This effect was opposite to the expected effect, and intent, of *Another Chance* as a condition. Even though the same effect on victim blaming attitudes was found for *Power and Control*, those who played through the narrative of *Another Chance* who also reported feeling a stronger connection to its protagonist subsequently reported more negative attitudes on exactly the issues facing that protagonist. Because this effect was found in a regression within one condition, causality has not been established; it is not clear whether the identification influenced attitudes or whether these were simply correlated. In previous research, perceived similarity to a victim of sexual abuse (a measure overlapping our identification scale) had coincided with less lenience towards abusive behavior and reduced victim blaming (Bell, Kuriloff, & Lottes, 1994). Though the effect we observed seems to counter this, a third factor may have influenced our results. As one possible explanation, previous research has also shown that lenient attitudes on violence towards women can be found among individuals who have experienced this kind of violence in their lives (Crome & McCabe, 2001; Markowitz, 2001). In our sample, it is therefore possible that the negative relationship between character identification and attitudes towards abuse was caused by experience with abusive relationships similar to how experience with homelessness has been found to reduce readiness to donate to relevant charities (Steinemann et al., 2017). Those who had this experience would then have potentially identified more with the two protagonists of *AC* and *P&C* who were actively going through it during the game. Since the current study did not include measures of personal experience with abuse because of the ethical issues involved in posing such sensitive questions in a group-based experimental setting, this is only one possible speculative explanation.

Finally, results showed a weakly positive influence of cognitive identification (i.e., seeing the game as mirroring the real-world process of abuse) on subsequent attitudes held. The direction of this change was opposite to that of the game condition as a whole. It therefore does not

appear that the procedural rhetoric embedded in *Power and Control* is responsible for the game's effects. Similar to the results of character identification, it is possible a third variable influenced certain respondents to both report the similarities of the gameplay with abusive relationships and to report increased self-efficacy in recognizing and dealing with abusive situations. Since the total effect of the game was to *lower* self-efficacy, it is worth investigating whether experience with this issue could be causing the relationship between identification and self-efficacy. The positive correlation between the two identification measures used in this study provide an indication into the direction of such an effect, though no hard conclusions can be drawn here.

CONCLUSION

This study was to our knowledge the first effort to disentangle the attitudinal influences of emphasizing either a persuasive game's narrative or its procedural elements. Although the games did prove to have mild effects on players' attitudes towards dating violence, their relative influences could not be meaningfully differentiated from each other. This may be because both games were vetted by a jury on their intent to persuade players on the same topic, making them of roughly equal quality. Antecedents of attitude change as a result of narrative and procedural elements could not be reliably established in this study, since both measurements used had effects that ran counter to those the games were supposed to invoke. These results paint the picture of persuasive games as offering a similar persuasive influence as long as they were developed with the goal of attitude change in mind. Although further research is definitely needed in this area, persuasive games do seem to abide by the adage that 'all roads lead to Rome', and that emphasizing certain persuasive mechanisms over others might not necessarily lead to demonstrably different outcomes on player attitudes in the short term. This is not a negative result; it could be seen as evidence that persuasive games do not need to offer one specific type of experience, or even that lengthier games are inherently more persuasive. Apparently, game designers have some freedom in how they persuade players, opening the doors to games that discuss many different topics from equally varied perspectives.

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About the Editorial Board

We are pleased to present you with the first peer-reviewed volume of Journal of Games, Self, & Society. Here are the individuals who generously donated their time and effort to ensuring the quality of this book.

Kelli Dunlap Psy.D. is a psychologist and game designer. She has collaboratively developed games for organizations including the National Institute for Mental Health, VOX Media, and The Knight Foundation. She has been recognized nationally for her work on mental health and video games and has received awards including the Game Developers Conference 2016 Top 50 Speaker award, the Microsoft and XBox Most Valuable Professional Award, and a $100,000 fellowship for game design at American University's Game Lab. In May 2017, Kelli was recognized as one of 15 Early Career Games and Learning Scholars by the Games and Learning Early Career Network. She has been researching the intersection of digital games and mental health for over 10 years. She has trained licensed mental health professionals in the therapeutic use of video games, including using games with adolescent populations with social or emotional disturbances. She has designed games for educational and social-impact purposes, one of which was featured at Games for Change 2017 in the Civics and Social Issues track. She currently works at iThrive Games as a Mental Health and Games Specialist.

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Gabriela T. Richard Ph.D. is an Assistant Professor in the Learning, Design and Technology program at Penn State. She has conducted research on the ways that diverse youth and adults engage in learning, collaboration, identity formation, and self-efficacy with gaming, livestreaming, makerspaces and computing. She explores ways that technologies can be culturally-situated and inclusive, and employs intersectionality as a frame for understanding complex sociocultural relationships across gender, race/ethnicity, sexuality and dis/ability in media and design.

Susan Rivers Ph.D. is Executive Director and Chief Scientist at the nonprofit iThrive Games. iThrive aims to intentionally use and design games in the best interests of teens, to support their thriving. Susan oversees the strategic direction for iThrive and fosters the development of programs and a cooperative ecosystem of youth, game developers, researchers, parents, mental health experts, and investors and donors. She uses her expertise in emotional intelligence to enhance the social and emotional well-being of adolescents by accelerating the development and widespread adoption of interactive, evidence-based digital products. iThrive's work centers on engaging teens by creating shared spaces for them to express their points of view and co-design interactive experiences that are meaningful to them. We can't design *for* teens *without* teens! Susan earned her doctorate at Yale University where she later served on the research faculty in the Department of Psychology and co-founded the Yale Center for Emotional Intelligence. She has published extensively in scholarly journals and books, is co-author of several curricula for embedding social and emotional learning into academic instruction, and speaks at national and international conferences and events. Susan is a Fellow with the Billions Institute's Leadership for Large-Scale Social Change, and she lives and plays games in Newton, MA with her husband and three children. Susan invites you to join iThrive's growing community of researchers, game developers, studios, teens, and mental health professionals in its efforts to create more meaningful experiences with and for teens. Let's thrive together — visit ithrivegames.org to learn more!

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His doctoral research examined identity transformation and empathy in digital narratives and games, drawing on theories from the performing arts and human-computer-interaction. His ongoing work on "Transformative Play" draws on techniques from theater practice to create and explore playful experiences that communicate different perspectives on the world, encouraging players to viscerally inhabit new identities and experiences. His first book, entitled Nonverbal Communication in Virtual Worlds: Understanding and Designing Expressive Characters, was released in early 2014 by Carnegie Mellon Universities ETC Press.

His work incorporates physical objects, wearable technology, and interactive tabletops to explore embodied interactions with digital games and stories. His most recent game, *Magia Transformo: The Dance of Transformation*, uses costumes and movement to help players adopt the personas of witches and warlocks to uncover the secret magical history of the world.

About iThrive Games

The non-profit iThrive Games is committed to using and designing technology in the best interest of teens, to support their thriving. We work to ensure that technology, and games in particular, empowers teens to build their strengths and cultivate the social and emotional resources they need to navigate adolescence and make a healthy transition to adulthood. To learn more, visit ithrivegames.org.

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