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I've Got to Play That Game

An Analysis of Embedded Persuasion in Game Design

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Abstract—We explore the role of persuasion in game design through a combination of cognitive biases, the roles of the individual and society in persuasive game design and game play. We examine the role of scarce player resources in the areas of monetary, temporal, spatial and cognitive spheres on the persuasive nature of a game. We argue that a persuasive game contains three distinct elements: the element of surprise and attention, the element of alignment with cultural norms and the element of tradeoff between player resources and incentives to play the game. We also present the ethical implications of persuasive game design.

Keywords- *persuasion; game design; ethics; behavioral theories; explicit persuasion; implicit persuasion*
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I. INTRODUCTION

Crafting and embedding and argument into a product of any kind – a book, a device, a work of art – requires the crafter to think of a fundamental question: how can this product influence the behavior of others? That man is a rational being and draws unbiased, objective conclusions from the evidence at hand is a theoretical ideal; in practice, we are persuaded by the context as much as the content. Successful persuasion is a very intentional form of communication that results in a behavioral or attitudinal change within an individual. No one is a stranger to persuasion, whether that be through societal expectations, cultural norms, political influence, or the use of incentives [1].

Game design is no exception to the phenomenon of persuasion. The most popular games draw upon approaches from social sciences and behavioral theories to influence the player to devote scarce resources to the game. These resources are a combination of the gamer's monetary resources (costs of obtaining and playing a game), spatial resources (space required to store it), temporal resources (time required to learn and achieve proficiency), and cognitive resources (steepness of the learning curve). The gamer must evaluate the tradeoffs of employing varying amounts of these resources; hence the game designer attempts to alter the gamer's behavior so that the gamer chooses to play the game as often as she can.

In this paper, we present psychological theories that underline the art of persuasion and use this framework to understand game design. We study persuasive game design through the lens of context as well as content. We present three elements that define an outstanding persuasive game: (a) the element of surprise and consequent attention (b) alignment with cultural norms and (c) the tradeoff between incentives and resource expenditure. These elements are firmly rooted in cognitive biases, and we provide an outline of the different biases that affect these three elements.

Persuasion has been studied through a diversity of perspectives. In Nicomachean Ethics, Aristotle argued for activity in accordance with virtue. He wrote, "And just as at the Olympic games the wreaths of victory are not bestowed upon the handsomest and strongest persons present, but on men who enter the competitions- since it is among these that the winners are found, - so it is those who act rightly who carry off the prizes and good things of life [2]. In [3], Aristotle explained that persuasion is more complete when three types of artistic proofs (ethos, pathos, and logos) were embedded into one's public speech. If Aristotle would have been a video-gamer, perhaps he would have advanced the same arguments. In this analogy, the 21st century game developer would be the public speaker of the ancient days and the gamer would be the audience. Hence, if a gamer is persuaded to engage in the game, then likely the game designer coded the outcome of the game to be especially successful when the following components are in-play: 1) Good gamers (individuals who are ethical- ethos) triumph over evil; 2) good gamers (individuals who possess pity/compassion – pathos) are emotionally engaged in the action; and 3) good gamers are rewarded by logical moves (apparent proof/evidence- logos) over illogical ones.

Our theoretical framework of persuasive games is rooted in three elements: (a) the element of surprise and consequent attention (b) alignment with cultural norms and (c) the tradeoff between incentives and resource expenditure. Surprise elicits an emotional response. When surprise was accomplished through positive emotions, participants were more willing to be drawn to the idea [4]. Persuasion is also closely related to cultural norms. Norms that advance genuine social consensus are valued and legitimized [5]. Moreover, studies have

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indicated that marketing to collectivistic cultures versus individualistic cultures impact the persuasive impact [6]. The authors in [7] further studied persuasion through the lens of cultural norms – they found that "we are more likely to be persuaded by sources we perceive to be powerful, in authority, attractive, likable, or similar to us than by source we perceive as not possessing these traits."

Alignment with cultural norms has also been studied in [8], where the authors emphasized that in individualistic cultures, the goals of the individual are granted more weight than the goals of the collective. This cultural norm reflects strongly on how games promoting an individual victory are especially relevant. Finally, the roles of incentives and resource expenditure are integral to persuasion. The authors in [9] studied the role of incentives in persuading people to actively participate in online knowledge-sharing forums such as Yahoo! Answers, Stack Overflow and Amazon reviews. Active users are rewarded for meaningful contributions with virtual incentives such as badges, "up-votes" and ratings. The authors used a game-theoretic framework to explore the utility of offering incentives in various scenarios, where the virtual rewards where earned by meeting a fixed or variable set of actions.

We also explore the role of technology in persuasive game design. An extensive survey evaluating the role of technology's influence on human behavior [10] showed that technology offers effective ways to disrupt habitual behavior such as physical exercise, shopping and eating habits, health and hygiene as well as energy usage and environment conservation. They found that lasting behavioral change could be achieved by engaging with the technology for extended periods. Networks make it possible for a lone player to team up with other players remotely and engage in multi-person, role-playing games. Games have also become smart: technology allows the games to evolve so that the game interface is constantly learning from the gamer's strategies and presenting advanced challenges to continue the game. Makers of online games are constantly gathering data from the devices that gamers are using to play games [11]. The frequency, fervency and speed of screen clicks are monitored to find whether the games are engaging users sufficiently and if not, personalized recommendations for other games are provided based on user's browsing history and gaming history. These data points that are associated with a gamer's IP address provide a trove of information to artificial intelligence algorithms that then craft persuasive ads that are tailored to the gamer.

Contrary to popular opinion, persuasive attempts by providing too many options can backfire. This phenomenon, called *decision fatigue* in the theory of decision making studies, explains why programs with fewer options perform better than programs with more options. An example of this is [12] where the authors show that providing multiple options for candidates to voters before an election resulted in voters using shortcuts to aid in their decision to vote. The decision fatigue induced by offering multiple options resulted in voters choosing the status quo such as voting "no" to propositions, choosing the first candidate listed on the ballot, and increasing the number of abstentions. In [13], the authors study feature fatigue, which refers to user behavior when presented with multiple features on devices. The authors show that when consumers are presented with products, they tend to weigh complexity higher than usability before use and hence products with complex features might have lower lifetime usability.

The appearance of the persuader also plays a role in the success of the persuasion attempt. In [14], the authors studied the impact of human persuaders and anthropomorphized messengers (talking products such as talking bubbles, talking oven mitts and the like) on the perceived trustworthiness by participants. They found that people low in interpersonal trust deemed the persuasion attempts conducted by anthropomorphized products to be more trustworthy than those conducted by people. On the other hand, the appearance of the persuader did not play a role in the success of the persuasion attempt for people high in interpersonal trust. However, when asked to be attentive to the message, people high in interpersonal trust valued the message delivered by people more than that delivered by anthropomorphized products.

We also study the visibility of persuasion (explicit or implicit) in the context of game design by examining the intended and sometimes, covert outcomes of playing games. To do this, we analyze games with explicit persuasive elements (MoviPill, Smart Lunch Tray and Molarcropolis) and implicit persuasive elements (Scrabble, Portal, Call of Duty). Through a combination of games played on multiple platforms, we apply our framework of the three elements that make a game persuasive (the element of surprise and attention, alignment with cultural norms and tradeoff of incentive versus resource expenditure). For each of these games, we also examine the use of player resources (temporal, spatial, monetary and cognitive) and analyze their impact on the persuasive nature of the game.

Is persuasion ethical? We examine the ethics of persuasive game design for games with both explicit and implicit persuasion since persuasion is a complex phenomenon that contains features of social and individual influence. To study the impact of social influence, we look at the role of distractions, timing of persuasive message, peer pressure and group involvement. We look at social influence through the lens of persuasive games, since in addition to being a form of entertainment, games have now made their way into education, personal health care and even military applications. The role of individual influence is analyzed through the elements of source credibility and perceived complexity.

Ultimately, this investigation utilizes elements from social persuasion theories, successful non-digital and digital games, technological platforms and human-computer interaction to analyze the design and development of persuasive games. Following, Section 2 presents examples of explicit persuasion, where users are outwardly persuaded to make smarter choices in the areas of personal health and energy conservation. Section 3 presents games with implicit persuasive elements. In Section 4, we discuss the ethics of persuasive games. Section 5 discusses social persuasion theory as it impacts gaming. Finally, Section 6 presents closing thoughts on the design and playing of persuasive games.

II.   GAMES WITH EXPLICIT PERSUASION

This section focuses on technological implementations of persuasive game design for two explicit outcomes: improving user health and improving awareness of energy conservation.

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A. Persuading People to Live Healthier

Numerous studies have been performed to determine the persuasive abilities of games targeted at promoting healthy behavioral changes [15-17], specifically in the areas of proper diet and exercise.

The desired goal of the study in [15] was to promote behavioral change in the dietary habits of young children. The researchers in this study attempted to reach this goal by creating a Smart Lunch Tray (SLT). The tray acted as an interactive game that provided children with feedback based on which foods they were eating from their plate. The target audience for the smart lunch tray was children between 3 and 6 years old; therefore, the game had to be simple enough for them to understand and attractive enough to draw and maintain their attention. The SLT evokes surprise and attention with its simple design and interactivity, and uses positive reinforcement to implement the persuasion portion of the persuasive game.

Persuasion via positive reinforcement is a common choice among those attempting to promote a behavioral change; this worked well with the children because the activity required minimal complexity while providing a desirable goal. The creators of the SLT made the persuasive game enjoyable by incorporating game design. Children were given free rein to eat whatever they pleased and were rewarded with an output that sparked their interests. The researchers noted that incorporating the positive reinforcement into a game element encouraged the children to explore other means of generating a desired outcome. The ease of use of the SLT game required minimal expenditure of the children's resources (temporal, monetary, spatial and cognitive), while the incentives to keep playing were high. The SLT was not only persuasive and engaging, but the game also promoted social interaction between the children. A spectator and at-play dynamic naturally occurred because of the fun nature of the persuasive game. This kind of reaction from the at-play children reveals how important social interaction is to the longevity and influence of a persuasive game. The social interaction afforded by the smart lunch tray game further ties in with our proposed theory of what makes a game persuasive: alignment with cultural norms increase status in the group and provides additional incentives to keep playing the game.

In [18], the authors presented the creation and testing of a mobile game called MoviPill that attempted to persuade elders to be more compliant with taking their medication. The desired outcome of the user's involvement was that the user would remember to take his/her medication and not loathe doing so. The creators valued social interaction and a high level of entertainment as the main methods for persuading users. The main form of persuasion came from the social interaction between users. The creators of MoviPill targeted an elderly audience, which influenced them to create a form of social media that came through the application itself rather than relying on an outside source. Through this form of social media, users saw how well they were doing compared to other players through the form of emoticons and points; the users gained points when their medication was taken on time and correctly. The social aspects of this game were the primary motivator for the user to continue playing; all game elements were wrapped up in social media. The creators of MoviPill made an effort to encourage users to take responsibility for their medication by the omission of reminders until fifteen minutes past the expected dosage time. MoviPill encouraged long-lasting behavioral change by allowing the user to obtain points only if they remembered to take their medication on time.

Elders were the main target audience of MoviPill, thus simplicity was a necessity for the game to be successful. They achieved simplicity by only letting users track their progress based on a points system and an emoticon on the social media page. The users participated in the game through taking their pills from a pill box with a special sensor. By limiting the amount of interaction that the user performed to gain points, the creators focused on the key element of the issue: remembering to take pills. Through simplicity and social encouragement, the results of this study revealed an increase in the amount of people who took their pills on time (increase of 43% regimen adherence). The simplicity of the gameplay proved to be extremely beneficial in terms of appeal that successfully engaged an audience with minimal experience with advanced technology. Like the SLT, MoviPill exhibited the three characteristics of a persuasive game: surprise and attention, easy to play (higher incentives than resource expenditure) and cultural norms (creating a culture of compliant pill-taking).

Similarly, in [19] the authors studied persuasive efforts to promote the adoption of a healthier lifestyle. Here, the authors used the Theory of Reasoned Action (TRA), which explains the relationship between behavioral intent and behavioral adoption, to develop a mobile application called STEP UP. STEP UP seeks to encourage users to pursue a healthier lifestyle by tracking and sharing the number of steps that the user has taken through the day. Although STEP UP is not a video game, it contains elements of competition that is inherent in games. Thus, the approach of sharing the individual's step count contains social motivation and competition, two elements that are commonly found in games. Using the two-pronged approach of goal-setting and social motivation, STEP UP ultimately induced behavioral change by persuading users to adopt a healthier lifestyle through data-sharing and communication.

Other elements of game play have been harnessed in designing persuasive video games to promote healthier lifestyles. The work in [20] described the impact of feedback in a brain-training game. Participants were chosen to play Concentration, an online game to improve visuospatial memory. Players were given feedback in three categories: descriptive, comparative and evaluative. While negative feedback was shown to improve the player's short-term goals such as playing the games again to improve scores, positive feedback was shown to increase long-term play and improvement in brain-training outcomes.

B. Energy conservation

Multiple studies [21-23] have been performed on the application of persuasive games to focused on energy conservation. In [21], the authors created a game called Power Explorer that monitored the users' power usage. The desired outcome is to make the user more aware of their energy consumption. Power Explorer was created on the premise that the public is unaware of how their actions in the home affect their energy consumption. Thus, Power Explorer ties in with the element of alignment to cultural norms in our framework of

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persuasive theory. The desired behavior is promoted via cues on behaviors and basic social cues from peers. In Power Explorer, users can get immediate feedback on their real-world tasks within the home. The creators of Power Explorer made the decision not to give direct instructions on how to reduce energy consumption within the home, but instead relied upon immediate feedback based on the user's actions. These responses are provided by various measurements made throughout the home and by visual cues given to the user via the mobile application. The feedback given to the user is virtually instant, clearly visible, and individualized. The user interface provides an engaging display as a response to the user's actions, motivating her/him to continue with the desired actions.

The creators of Power Explorer have attempted to instill the desired behavior within the user via shallow cues and social involvement. By refusing to provide explicit information on what the user needed to do to achieve a higher score, the game designers reduced the amount of information that the player had to obtain while playing the game. The user was affirmed through various responses to his/her actions, making learning less cumbersome. Ultimately, the resource expenditure (temporal and cognitive) was minimal, and yet the incentive to keep playing yielded monetary benefits. An issue that arose from the lack of explicit information given in Power Explorer was the effect of learning the game and not the intended message. Power Explorer's solution to this problem was to make the game social, promoting conversation between users and even non-users. Social interaction between users and others had the potential to generate thoughtful discussions about the intended message of the game. The creators considered communication to be a key element in conveying the message of energy conservation in Power Explorer; they executed this element through conditions in the game that direct social formation and communication.

III. GAMES WITH IMPLICIT PERSUASION

Implicit persuasion abounds in everyday life. Traffic rules, etiquette, manners and norms are all intended to persuade us to make certain choices. While we may not view a traffic signal as a persuading element, the signal comprises all the key features of persuasion: it appeals to a desire to avoid conflict and settle into routine behavior. Violators of traffic rules are thus, not persuaded of the need to maintain order in vehicular traffic through their actions. Examples of such invisible persuasion are numerous. The lens of persuasion to study our everyday behavior has been used to examine pedestrian walking behavior [24], driving [25], profiling [26], exercise [27], mitigation of blind spots in making inferences [28], and even diary writing [29]. In essence, all of our quotidian activities can be viewed as the outcomes of various kinds of persuasion. In this section, we examine games with hidden persuasion and highlight Scrabble as a popular game whose true persuasion lies not in building vocabularies, but rather in improving cognitive skills.

A. Scrabble

Scrabble is an internationally popular game. Currently, the game is available in 29 languages and an estimated 150 million Scrabble sets have been sold; these numbers only reflect physical copies of the game and not digital adaptations [30]. Scrabble is said to exist in three of every five American homes.

Scrabble is not only a popular living room game, there are also numerous international tournaments based around the board game. These tournaments are timed games regulated by their own dictionary and etiquette rules. In a game of Scrabble, two players are each given seven letter tiles with which they must strategically attempt to form into words; these words are then placed on the game board. Points are allocated based on the point values of each letter tile as well as bonus modifiers located on the board itself. The language itself acts as a cognitive burden on the player, thus the simplicity of the game elements is vital in promoting continuous play of the game.

Scrabble does not require much monetary investment on the part of the player. Scrabble does not require a large spatial resource to play the traditional game. Additionally, the minimal requirements for both types of resources (monetary and spatial) increases the appeal of a game with heavy amounts of cognitive requirements. Although there are not many cognitive requirements to begin playing a game of Scrabble, many cognitive resources are required to be a Scrabble champion. Expert players have been reported to know the existence of over two hundred thousand words from the official Scrabble dictionary. Players are required to not only focus on the game itself, but also all the possible combinations of letters in their language. Often players are penalized for time and nonexistent words, so players are encouraged to make a strategic play quickly and accurately [30].

To compensate for the heavy cognitive load on the player, the game's mechanics must be relatively simple. One method of reducing cognitive load is the reduction in the number of letters available to create the word. By giving players seven tiles to manipulate, their options become more limited, rather than having all words in the Scrabble dictionary as options. The players are also limited in the fact that they must build off other words already on the board. Limiting word selection allows players to focus more heavily on a smaller set of words and possible plays, and ultimately reduces the cognitive resources that the player must provide.

A study performed by [31] indicated that when presented with a lexical decision task, expert Scrabble players rely on the part of the brain often associated with working memory and visual perception rather than meaning retrieval in word recognition. This evidence proves that expert players have not become good at the game solely because they wanted to improve their memory; they did the minimal work to reap the greatest benefit. A telling example is that of Nigel Richards who won the French language Scrabble World championship in 2015. Nigel Richards is a native of New Zealand who does not speak French, but relies on his memory to bring back images of words that he has seen on dictionary pages and word lists [32].

Scrabble has the incentive appeal of making a person appear smarter; this empowers the player, persuading them to keep playing and attempting to improve. People commonly associate intelligence with word recognition, so by focusing on that element, Scrabble promotes the idea that a person who is better at the game is also more educated. Even players who recognize that this misconception is false are empowered by the fact that they have improved, and in a sense mastered, their cognitive memory. The simplistic game design allows users to focus on the mental aspects of the game, but the points system is what truly inspires players to improve their word recognition skills. By limiting the cognitive requirements through

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gameplay design, the prospect of appearing more intelligent while participating in an entertaining game becomes even more enticing.

B. Portal

In October of 2007, Valve Corporation created the single-player puzzle game, Portal. Portal is set in Aperture Science Laboratories where players must solve puzzles by "…opening portals, maneuvering objects, and moving themselves through space in ways that used to be impossible" This game earned Valve over 70 industry accolades, and the game continues to have a cult following. Valve has also developed a learning curriculum [33] to accompany the second installment of Portal where educators are provided free access to both the lesson plan and the games. Valve supplies lessons for physics, math, game design, and language arts. In these lesson plans, students can both engage in playing the game as well as to create various levels for others to play; this provides players with a sense of experimentation with concepts related to physics. Players can directly manipulate objects in the game and see the difference between their expected outcome and the actual outcome. By connecting lesson plans to the experimentation that the game already provides, Valve is making it even easier for teachers to promote the use of video games as a tool to encourage STEM engagement.

The authors in [34] conducted a study about the effects of Portal on understanding physics concepts and spatial skills. In this study, a group of individuals played Portal for one hour before being presented with a slide show about the laws of motion; the players were then asked to take an assessment based on their knowledge of these laws of motion1. Based on their findings, there was no correlation between Portal and the laws of motion, but they did find a correlation between Portal and spatial cognition skills and corresponding success in STEM subjects. Players are required to place portals in a given space to accomplish their goals; thus, it is imperative that the players utilize spatial orientation – "the ability to visualize what a different perspective may look like from another location". Valve has incentivized the idea of creatively placing portals and other objects by preventing the player from progressing in the game. Players must also utilize properties of gravity and momentum to progress to the next level. In these ways, players are rewarded for utilizing their spatial cognition skills. Although the implementation of Teach with Portals ties a direct correlation between elements of physics, spatial cognition, and Portal, the game by itself has enough persuasion to motivate players to improve their spatial cognition. The players are motivated by their desire to achieve the goal of completing the puzzle as well as their desire to get the protagonist, Chelle, out of the laboratory. Although most players do not know that they are improving their spatial skills, they only know that they are slowly getting better at the game.

C. Call of Duty

The Call of Duty franchise is a set of video games that portray various war-like situations; they have been around since 2003. The Call of Duty franchise has been one of the best-selling videogame franchises of all time. In 2010, Frédérick Gagnon conducted a study [35] which compares two of the games from the Modern Warfare story arc of the Call of Duty series with the United States' response to the September 11, 2001 attacks. Gagnon found that these games (1) reinforce post-9/11 geopolitics; (2) glorify military power and the idea that wars are inevitable; and (3) desensitize the negative consequences of war. Both the story and the gameplay of these games work together to present these ideas to the player, although the main motivation for the creation of these games is entertainment value.

IV. ETHICS OF PERSUASIVE GAMES

Sometimes persuasive attempts can be plainly obvious to the audience, but far too often, the audience may not be aware of the persuasive agenda. What measures need to be taken to ensure that a persuasive game is erring on the side of persuasion and not manipulation? The persuader's motives indicate the extent to which the influence attempt is ethical [9]. In [3], Aristotle explained, "What makes a man a 'sophist' is not his faculty, but his moral purpose". In other words, a person with integrity will have a positive moral agenda when s/he speaks. Moreover, Quintilian [3] argued that if a persuader is seeking to persuade for the common good, even if the persuasion is not achieved, the person effectively "attained the full end of his art". Though Aristotle, Quintilian, and other ancients were primarily discussing the ethics of oral persuasion, the following question remains: is it even ethical to persuade someone by hiding influential elements in a game?

In the case of persuasive gaming, the audience often considers the "character" of the technology used, not the designer. At the most, the player may consider the company producing the game when playing a game, but the likelihood that the player knows the character of anyone involved in the design process is slim. Often, players rely on their perception that a computer is "intelligent and fair" when considering its character [36]. This positive outlook on the computer can distort a player's view on the persuasive intent of a game. In contrast with that, a negative view of computers or video games could make it increasingly difficult for the designer to get a message across even if the message is deemed as ethically acceptable. Understanding the player's perception on the medium of choice for persuasive game design can have implications on the design as well as the ethical considerations.

Ethical considerations should be made for both intentional persuasion as well as unintentional persuasion. Much of the controversy [37-39] about children playing video games is centralized around unintentional persuasion; game developers are not solely creating games to encourage violence, often their ultimate persuasive goal is entertainment. One method of dealing with this controversy is the use of a rating system. The rating method is an important tool for parents to utilize when deciding whether their children can play a specific game. The rating system also provides game designers with general guidelines for the rating system to deter unintentional persuasion. Although unintentional persuasion may be harder to detect and control, it is an important aspect of the ethics of game design.

In [40], the author discusses the role of persuasive technology and the freedom of being human. In many ways, technology provides and restricts freedom simultaneously by relieving individuals from tasks as well as influencing or controlling them. In persuasive game design, the loss of control is not as heavily apparent as the amount of influence. The author's example of a car that uses GPS Location to determine

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the maximum speed and limit the driver to that speed is an example of persuasive technology with significant control. If there was a game that was designed such that the user got a certain number of points for driving the speed limit, then we would argue that the user was influenced to drive the appropriate speed limit; that is, the amount of influence was great but drivers continued to have freedom to drive as he/she saw fit. Although persuasive games do not completely hinder the player's freedom, they do pose a threat to the player's freedom by incorporating all three persuasive elements.

The authors in [41] describe a "golden rule" of persuasion by stating that "the creators of a persuasive technology should never seek to persuade anyone of something they themselves would not consent to be persuaded of". While this golden rule may assist those who are intentionally persuading others, unintentional persuasion complicates the design. Games that are unintentionally persuasive in design can work against the ethics of their audience. However, as persuasive technology advances in the world, there should be a clear distinction between what is intentionally persuasive and what is unintentionally persuasive. The audience should be able to distinguish between these two forms of persuasion so they do not make behavioral changes that promote poor ethical choices. This responsibility lies on the developers and designers of persuasive games and technology; the more that the lines are blurred between technology and humans, the more effort needs to be put into ensuring that persuasive elements are aligned correctly with ethical expectations.

V. INSIGHTS FROM SOCIAL PERSUASION THEORIES

This section describes behavioral (individual and group) features that influence persuasion [42]. Behavioral change through persuasion is ancient: Eve successfully persuaded Adam to taste the forbidden fruit. What persuasive elements most influence the audience? Here, we seek to identify critical persuasive elements and apply those elements to persuasive game design.

A. The Role of Social Influence

Technology presents multiple avenues for distraction. Notifications of unread emails, pop-ups, push messages from applications, alarms and social media messages all beg for scarce attention while creating numerous opportunities for cognitive multitasking. In this section, the role of distraction in persuasion will be analyzed. By combining insights from social persuasion and modern technology, this section will analyze the extent to which distraction promoted or hindered the cause of the persuasive game.

1) Distractions: The work in [43, 44] studied the impact of distraction on persuasive communication. In [43], the authors conducted a study where fraternity members were shown a movie that argued against the presence of fraternities. One group of fraternity members was shown the movie without distractions, and the second group was shown the movie with an irrelevant silent, amusing movie playing in the background. The results showed that students who were distracted were more likely to be persuaded by the message arguing against campus fraternities. Further work on the distraction hypotheses was conducted by [44], where the authors studied the impact of distraction on two arguments: one in favor of reducing the national voting age and the other against reducing

the national voting age. A humorous visual was superimposed on these messages to provide visual distractions. Behavioral distractions were introduced by having subjects of the study fill out multiple choice questionnaires and a page of semantic differential terms. The results of this study were opposite to that of the results in [43] subjects who were not distracted at all produced the most attitude change.

Other forms of distraction have been studied. The presence of the ubiquitous "coffee and snacks provided" phrase in flyers does provide an ulterior motive. The pleasures of eating as a distraction have been studied in [45]. In this work, the authors found that the gratifying act of eating increases the persuasive ability of the message. The findings of this study have significant implications on the structure of marketing efforts, business meetings, social settings and political campaigns. How might one use these results in persuasive game design? Digital games incorporate distraction in the form of advertisements. A study in [46] showed that advertisements during game play that were related to the game, the player or advertisements that were for new or local events showed higher recall superiority. Distractions in a game in the form of commercials can help to boost the popularity of games. Commercials for new games would do well to target players who play games in similar genres. Further research [47] on the brand placement in video games revealed that younger children who had no prior experience with a brand were more easily persuaded than older children by brand placements in games. The authors attributed this persuasion to two factors: age and prior brand usage. The authors also showed that the perception of the brand placement affected the perception of the game itself: positive perception of the brand led to a positive perception of the game. Thus, brand placement achieved persuasion on two levels: persuading the player to play the game, persuading the player to engage with the brand.

2) When should the persuasive message be stated?: Educational games are a unique set of games where the outcome of game play is related to education through entertainment. Unlike in conventional games where the outcome is only entertainment, the makers of educational games have the added task of improving the knowledge base of the player. Insights from persuasion theory have shown a correlation between the positions of the persuasive communication on message recall [48] and influence on group decision [49]. The work in [48] found that news items listed during the beginning or end of the newscast had the highest recall. Similar effects of position were found in a study performed by [49]. The authors in [49] studied the influence of opinions on group decisions as a function of the timing of the opinions. Results of this study revealed that opinions stated at the beginning or end of group discussions had the most influence on the group decision, whereas opinions stated in the middle of the discussion had the least influence. How might these insights on timing affect the persuasiveness of a game? Educational games would do well to state the message at the beginning of the game while introducing the ruleset, and reinforce the message at the end to promote recall and influence opinion change.

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Additional reinforcement of the objectives of the game may be achieved through group involvement and participation. Experiments performed have shown that the persuasive communication achieved its outcomes more successfully when the communicated message was presented to and accepted by the whole group rather than when the communicated message was presented solely to the individual [50, 51]. Group dynamics are a powerful influence in human society. The tendency to be favorably considered by groups of individuals is a strong motivator and group dynamics serve as a persuasive element in most interaction. The term massively multiplayer online game (MMOG) refers to games that are capable of supporting participation by multiple players at the same time in the game environment, where players can compete and cooperate to advance through the game. A subgenre of MMOG is that of massively multiplayer online role playing game (MMORPG) which refers to games where the players control the actions of a single or multiple game components through a well-defined environment. MMORPGs are immensely popular – World of Warcraft is the world's largest MMORPG with around 9 million subscribers per month [52]. Through a phenomenon called persistence, the game environment, referred to as the "game world" continues to exist and evolve through the play sequences initiated by the gamers even when they are offline. The technological requirements to maintain persistence are immense – MMORPGs have to resort to building custom hardware and software to support the complex game environment and the ability of players to build social networks through game play.

3) Games as ultimate influencers: The capability of games to influence a generation of people is unparalleled. As of 2015, video game sales were the third highest in the entertainment industry trailing only behind broadcast and cable TV. Games thus present a powerful platform for opinion change and cultural influence and showcase a key feature of persuasive communication: a person's everyday behavior can be influenced by the behavior of total strangers [53]. How much time do gamers invest in game-playing? In a study that tracked the gaming habits of more than 10 million mobile gamers over 90 days [54], it was found that 19% of the players opened the game only once, and two-thirds of players stop playing after the first day. The statistics for video gamers are different: serious gamers spend about 22 hours a week playing video games. This difference can be attributed to the immersive game environments afforded by most video games that are not possible in mobile games.

The immersive game environments offer challenging rulesets and complex scenarios which take a significant investment of time to build the analytical and strategic skill set required to advance through the game. These games have spurred virtual economies: often the monotonous tasks of gathering resources such as weapons or firewood is outsourced to gamers in exchange for monetary benefits [55]. The presence of MMOGs takes this a step further: the game never really ends even when the player is not playing.

B. The Role of Individual Attitudes

While the previous section looked at the role of social influence on persuasion, this section examines the role of the individual's underlying attitudes on persuasive game design.

Specifically, we look at the role of source credibility and perceived complexity of the game. We also present (unintended) beneficial consequences of persuasive game design and the widespread applications.

1) Source credibility: Multiple studies have been performed on the credibility of persuaders as a factor in the success of the persuasion attempts. In [56], the authors studied the impact of sources of varying credibility (high, medium and low) on attitudes toward smoking cessation. These three sources in order of decreasing credibility were the Surgeon General's Report on Smoking and Health, Life Magazine and an advertisement. Results of this study revealed that as the credibility of the source increased, the percentage of subjects who agreed with the information and considered it trustworthy also increased. Another study investigating the impact of source credibility was conducted in Howland. The authors presented a message to two groups, one from a generally "trustworthy" source and the other from a generally "untrustworthy source." An example of this is the question, "Should anti-histamine drugs be continued to be sold without doctor's prescription?" The trustworthy source chosen was the New England Journal of Biology and Medicine and the untrustworthy source chosen for the study was a mass circulation monthly pictorial magazine. Results of the opinion questionnaires that were administered to the subjects after the study showed that significant opinion change was impacted by attributing the communication to sources of higher credibility.

Technological persuaders come in various forms. In [57], the authors defined microsuasion as products that do not necessarily have a persuasive outcome as the end goal. Instead, products such as spreadsheets and word processing programs use persuasive elements such as dialog boxes, notifications and other visual elements to influence the user to achieve other goals. Video games are noted for their reliance on the elements of microsuasion. The author notes that educational games, specifically, can use the seven basic intrinsic motivators [58]: challenge, curiosity, fantasy, control, competition, cooperation and recognition to persuade the user to keep playing and achieve other goals, in addition to entertainment, such as accumulating in-game tokens, higher playing skills (advanced levels) and social recognition (playing with friends).

Video games have also been used to create awareness of social causes. Games For Change [59] is an organization that is focused on providing a platform for games that are intended to use the persuasive power of games for social good. Ruggiero [60] conducted a study to assess the impact of the game *Spent* on player attitudes toward homelessness. The impact of Spent was studied on middle-school and high-school students, where the game play took the players through a series of events modeled after financial constraints in the life of a homeless person. Each action performed by the player for allocating resources, such as buying food, paying for transportation and insurance had an impact on the player's "money barometer." The study found that Spent significantly improved player's attitudes towards homelessness by influencing the player's affective learning and attitude change as evidenced by higher scores on the Affective Learning Scale (ALS) and the Attitudes Towards Homelessness Inventory (ATHI).

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2) Perceived complexity: Do complex games do well? Both digital and non-digital games can be classified into two broad categories based on the rule set: simple and complex. The rule sets of simple games such as Sudoku, Tetris, and Angry Birds can be summarized with a few lines. For example, one rule that defines Sudoku is that a number should be unique to its row and column. Similarly, Tetris is defined by block elements of various shapes that are placed with minimum number of holes in a wall. Simple games require a few minutes (crosswords, anagrams, Candy Crush) or hours to play and thus the resource expenditure for time is minimal. On the other hand, complex games such as Chess, elaborate card games, and many modern video games have extensive rule sets.

Elite: Dangerous is a video game that immerses users into a massive universe that has more than 400 billion individual star systems. Reviews of the game noted upwards of 30 hours in merely traversing from the starting point to the Earth's home system. Multiple modern video games are similar in the aspect of resource expenditure for time: massively multiplayer online games require dozens of hours to get acquainted with the game plot and learn the game. In the face of such increasing complexity, we ask the question: how popular are complex games? Are users facing increasingly complex worlds because they are good at playing the game, or are the makers of games asking more from their users by increasing the complexity of their games?

The work in [61] argued that video games demand far more resources of the player than traditional games such as Monopoly. These resources include learning the game objectives and how to complete them, the game environment and controller abilities and most importantly – the strategic skill set needed to advance through the game. These results are in line with the research performed by [62], which showed that the more extreme the opinion change that was sought, the more actual change was achieved. This study demonstrated that communication advocating the most extreme change achieved the highest change in opinion.

We refer back to our framework of what makes a game persuasive: the element of surprise and consequent attention, alignment with cultural norms and the tradeoff of incentives and resource expenditure. Modern video games undoubtedly rank high on the elements of surprise and attention with complex game environments. The massive popularity of games also indicates that the tradeoff between incentives and resource expenditures skews favorably toward higher regard of the incentives to keep playing, despite the significant temporal and monetary expenditures. Games are also an integral part of our culture. A report by Spil Games in 2013 about the state of online gaming [63] estimated that more than 1.2 billion people worldwide were playing video games.

In addition to increasing the size of the analytical skill set and exposing the user to varied and complex game environments, modern video games come with a spectrum of "beneficial" side-effects. The research in [64] suggested that incorporating games into the learning process could result in better educational outcomes. Games that used controllers to simulate objects imparted the additional benefit of dexterity – a study of laparoscopic surgeons found that surgeons who were gamers were faster at advanced surgical procedures and made fewer errors than surgeons who were not gamers [65]. Gamers also exhibited superiority in spatial cognition in Green & Bavelier's [66] study, where the authors show that game playing enhances the ability to learn new tasks. Such outcomes of game design coupled with their widespread appeal have been instrumental in influencing key areas such as education and military applications, where games have been embedded in various forms.

For example, the immersion afforded by virtual reality gaming systems and their uses in military applications were discussed by [67]. Some of these applications include simulated versions of a military engagement, Virtual Battlespace, a game tailored only for the military for simulating realistic battlefield scenarios and America's Army Project, which can be used by potential recruits for activities such as practicing weapons and handling arms and ammunition. Specialized equipment such as head mounted displays (HMDs) are used for expanding the field of vision through virtual reality (VR) feeds for tank drivers, and the ubiquitous Xbox controller that has found its way into maneuvering small unmanned ground vehicles and developing directed energy weapons capable of emitting a highly focused beam of energy. An online addictive puzzle game, EteRNA has turned citizens into scientists and authors of a published paper on RNA folding mechanisms. EteRNA is an interactive visual puzzle dealing with the design ability of RNA structures and has implications for modes of RNA communication with other parts of the cell and consequent treatment options for diseases based on the various folding patterns. This work which was subsequently published [68] resulted from the RNA folding patterns made possible by non-scientist players of EteRNA, and opened the doors for scientific discovery by non-scientists using the principles of persuasive game design.

Finally, we look at individual preferences as factors that influence the games people play. Do game genres matter? Much of what makes a game persuasive is the ability to attract new users and to keep them engaged in the game – element of surprise and consequent attention. To devote attention to the mechanism of gaming, do players follow the path of increasingly complex games moving from word or puzzle games to elaborate video games?

Early research conducted to determine the composition of the audience in terms of alignment with the persuasive message showed that audience members expose themselves to messages that were already a part of their interests [69]. This "selective exposure" phenomenon was described in [70] where they found that people in favor of the Vietnam War attended Lyndon Johnson's speech at a university promoting the cause of Vietnam War. Reports by the Entertainment Software Association [71] about gaming statistics in 2014 and 2015 reveal that the gaming audience is becoming more diverse. Women gamers now make up 47% of the gaming population, and people over the age of 50 comprise 29% of the population. 91% of games are geared toward children and young adults. These and other important statistics show that games are becoming embedded in multiple facets of our society. This widespread appeal of games ensures that gamers will explore different genres in their gaming lifetime and try their hand at games of varying complexity.

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VI. CONCLUSIONS

Games are embedded into various aspects of the modern human experience. Applications of games have extended beyond entertainment– deliberate attempts are made at incorporating a game-like environment in education, healthcare and even military applications. This work raises several questions: Are games becoming popular because of their tendency to persuade people to achieve a certain outcome? For example, is a classroom game to understand the periodic table of elements better than a conventional lecture? Does incorporating games into scientific research increase the efficiency, appeal and outreach of the research? Is persuasion more successful when delivered in a game-like environment? The tendency of games to appeal to the human nature of exploration and adventure (albeit through smartphones, gaming consoles or physical objects like chess pieces) lends them a powerful platform to persuade. The degree and extent of persuasion incorporated into the game matters: a balance must be struck between simplicity and complexity, an element of surprise and attention must operate, and providing the player more incentives than resource expenditures is crucial. Moreover, ethical boundaries underline the element of persuasion. Collectively, persuasive games have the potential of shaping the modern human. While games and play were once a realm of the human childhood experience, a culture of games has now arrived and pervades multiple facets of our lifelong human experience.

REFERENCES

[1] E. Kamenica, "Behavioral economics and psychology of incentives", The Annual Review of Economics, vol. 4, no. 13, 2012.

[2] H. Rackham, "Aristotle, Nicomachean Ethics 1.8", Cambridge, MA: Loeb Classical Library. : Harvard University Press, 1934.

[3] P. Bizzell, and B. Herzberg, B. (Eds.), The rhetorical tradition: Readings from Classical Times to the Present. Boston, MA: St. Martin's Press, 1990.

[4] E. R. Ramirez, "The role of surprise on persuasion in industrial design. International Journal of Product Development", vol. 16, no. 3-4, 2012.

[5] R. Payne, "Persuasion, frames and norm construction", European Journal of International Relations, vol. 7, no. 1, 2001.

[6] S. Han and S. Shavitt, "Persuasion and culture: Advertising appeals in individualistic and collectivistic societies", Journal of Experimental Social Psychology, vol. 30, no. 4, 1994

[7] M. D. Miller and T. R. Levine, "Persuasion", In An Integrated Approach to Communication Theory and Research, Lawrence Erlbaum Associates, NJ, 1996.

[8] R. H. Gass and J. S. Seiter, Persuasion, Social Influence and Compliance Gaining. Boston, MA: Pearson, 2007.

[9] D. Easley, and A. Ghosh, "Incentives, gamification and game theory: an economic approach to badge design", 14th ACM conference on Electronic Commerce, 2016.

[10] S. Hermsen, J. Frost, R. J. Renes and P. Kerkhof, "Using feedback through digital technology to disrupt and change habitual behavior: A critical review of current literature", Computers in Human Behavior, 61-74, 2016.

[11] N. Byrnes, "Technology and Persuasion", MIT Technological Review, vol. 118, no. 3, 2015.

[12] N. Augenblick and S. Nicholson, "Ballot position, choice fatigue and voter behavior", Berkeley: University of California, 2012.

[13] D. Thompson, R. W. Hamilton and R. T. Rust, "Feature fatigue: when product capabilities become too much of a good thing", Journal of Marketing Research, vol. 42, no. 4, 2005.

[14] M. Toure-Tillery and A. L. McGill, "Who or what to believe: trust and the differential persuasiveness of human and anthropomorphized messengers", Journal of Marketing Research, vol. 79, 2015.

[15] T. Lin, K. Chang, S. Liu and H. Chu, "A persuasive game to encourage healthy dietary behaviors of kindergarten children", 8th International Conference on Ubiquitous Computing, 2015.

[16] J. Lo, T. Lin, H. Chu, H., Chou, J. Chen, J. Hsu and P. Huang, "Playful Tray: Adopting Ubicomp and persuasive techniques into play-based occupational therapy for reducing poor eating behavior in young children", Ninth International Conference on Ubiquitous Computing, 2007.

[17] M. A. Adams, S. J. Marshall, L. Dillon, S. Caparosa, E. Ramirez, J. Philips, and J. Norman, "Theory-based framework for evaluating exergames as persuasive technology", Fourth International Conference on Persuasive Technology, 2009.

[18] R. Oliveira, M. Cherubini and N. Oliver, "MoviPill: Improving medication compliance for elders using a mobile persuasive social game", 12th International ACM Conference on Ubiquitous Computing, 2010.

[19] A. Khalil and S. Abdallah, "Harnessing social dynamics through persuasive technology to promote healthier lifestyle", Computers in Human Behavior, pp. 2674-2681, 2013.

[20] C. Burgers, A. Eden, M. Engelenburg and S. Buningh, "How feedback boosts motivation and play in a brain-training game", Computers in Human Behavior, pp. 94-103, 2015.

[21] M. Bang, M. Svahn and A. Gustaffson, "Persuasive design of a mobile energy conservation game with direct feedback and social cues", Breaking New Ground: Innovation in Games, Play, Practice and Theory. Proceedings of DiGRA 2009.

[22] L. Gamberini, G. Jacuci, A. Spagnolli, N. Corradi, L. Zamboni, M. Perotti, . . . and C. Bjorkskog, "Saving is fun: designing a persuasive game for power conservation", 8th International Conference on Advances in Computer Entertainment Technology, 2011.

[23] L. Gamberini, A. Spagnolli, N. Corradi, G. Jacucci, G. Tusa, T. Mikola, . . . and E. Hoggan, "Tailoring feedback to users' actions in a persuasive game for household electricity conservation", 7th International Conference on Persuasive Technology, 2012.

[24] G. Boehm, "Ambient Persuasive Guidance", In Proceedings of the Fifth ACM International Conference on Tangible, Embedded and Embodied Interaction, 2011.

[25] F. Verberne, J. Ham and C. Midden, "Trust in Smart Systems: Sharing driving goals and giving information to increase trustworthiness and acceptability of smart systems in cars", Human Factors, vol. 54, no. 5, 2012.

[26] M. Kapstein and D. Eckles, "Selecting effective means to any end: Futures and Ethics of Persuasion Profiling", Persuasive Technology: Springer Berline Heidelberg, 2010.

[27] T. Ainsworth, "Improving therapeutic exercise devices for people with rheumatoid arthritis: a research method combining cultural probes and persuasive design theory", Persuasive Technology, vol. 1, 2012.

[28] E. Bessarabova, C. Piercy, S. King, C. Vincent, N. Dunbar, J. Burgoon, . . . and Y. -H Lee, "Mitigating bias blind spot via a serious video game", Computers in Human Behavior, 2016.

[29] I. Mols and P. Markopoulos, "Dear Diary: A design exploration on motivating reflective diary writing", Persuasive Technology, 29, 2012.

[30] I. Hargreaves, P. Pexman , L. Zdrazilova and P. Sargious, "How a hobby can shape cognition: visual word recognition in competitive Scrabble players", Memory Cognition, vol. 40, no. 1, 2012.

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[31] A. B. Protzner, I. Hargreaves, J. A. Campbell, K. Myers-Stewart, S. van Hees, B. Goodyear, . . . P. M. Pexman, "This is your brain on Scrabble: Neural correlates of visual word recognition in competitive Scrabble players as measured during task and resting-state", Cortex, 2015.

[32] B. Chappell, Winner of French Scrabble does not speak French, from http://www.npr.org/sections/thetwo-way/2015/07/21/424980378/winner-of-french-scrabble-title-does-not-speak-french. Retrieved April 2016.

[33] Valve Corporation. Retrieved April 2016, from http://www.teachwithportals.com/

[34] D. M. Adams, C. Pilegrad, and R.E. Mayer, "Evaluating the cognitive consequences of playing Portal for a short duration", Journal of Educational Computing Research, December 2015.

[35] F. Gagnon, "Invading Your Hearts and Minds: Call of Duty®and the (Re)Writing of Militarism in U.S. Digital Games and Popular Culture", European Journal of American Studies, vol. 5, no. 3, 2010.

[36] J. Davis, "Design methods for ethical persuasive computing", 4th International Conference on Persuasive Technology, 2009.

[37] S. B. Silvern and P.A. Williamson, "The effects of video game play on young children's aggression, fantasy, and prosocial behavior", Journal of Applied Developmental Psychology, vol. 8, no. 4, pp. 453-462, 1987.

[38] J. B. Funk, D. D. Buchman, J. Jenks, and H. Bechtoldt. "Playing violent video games, desensitization, and moral evaluation in children", Journal of Applied Developmental Psychology, vol. 24, no. 4, 413-436, 2003.

[39] M. Griffiths, "Violent video games and aggression: A review of the literature", Aggression and Violent Behavior, vol. 42, no. 2, pp. 203-212, 1999.

[40] P. Verbeek, "Persuasive technology and moral responsibility toward an ethical framework for persuasive technologies. Persuasive, 6, pp. 1-15, 2006.

[41] D. Berdichevsky, and E. Neuenschwander, E. "Toward an ethics of persuasive technology", Communications of the ACM, 42(1), pp. 51-58, 1999.

[42] M. Karlins and H. Abelson, Persuasion: How Opinions and Attitudes are Changed, Springer, 1970.

[43] L. Festinger and N. Maccoby, "On resistance to persuasive communications", The Journal of Abnormal and Social Psychology, vol. 68, no. 4, 1968.

[44] G. Haaland and M. Venkatesan, "Resistance to persuasive communications: An examination of the distraction hypotheses", Journal of Personality and Social Psychology, vol. 9, no, 2, 1968.

[45] I. Janis, D. Kaye and P. Kirschner, "Facilitating effects of eating-while-reading on responsiveness to persuasive communications", Journal of Personality and Social Psychology, vol. 1, no. 2, 1965.

[46] M. R. Nelson, "Recall of brand placements in computer/video games", Journal of Advertising Research, vol. 42, no. 2, pp. 80-92, 2002.

[47] E. Reijmersdal, J. Jansz, O. Peters and G. van Noort, "The effectsof interactive brand placements in online games on children's cognitive, affective and conative brand responses", Computers in Human Behavior, pp. 1787-1794, 2010.

[48] P. Tannenbaum, "Effect of serial position recall on radio news stories", Journalism Quarterly, 31, 1954.

[49] M. Shaw, "A serial position effect in social influence on group decisions", Journal of Social Psychology, 54, 1961.

[50] A. Calvin, "Social reinforcement", The Journal of Social Psychology, vol. 56, no. 1, pp. 15-19, 1962.

[51] L. Nahemow and R. Bennnett, "Conformity, persuasibility and counternormative persuasion", Sociometry, pp. 14-25, 1967.

[52] L. Reilly, L. (2014 Nov). World of Warcraft Subscriptions back over 10 million. (IGN) Retrieved April 20, 2016, from http://www.ign.com/articles/2014/11/20/world-of-warcraft-subscriptions-back-over-10-million

[53] J. Bryan, and M.A. Test, "Models and helping: naturalistic studies in aiding behavior". Journal of Personality and Social Psychology, vol. 6, no. 4, 1964.

[54] E. Johnson, "Most Mobile Game Players Quit After One Day", (re/code) Retrieved April 20, 2016, from http://recode.net/2014/04/09/most-mobile-game-players-quit-after-one-day-exclusive/

[55] Fairfield, "Virtual property", Boston University Law Review, 85, 2005.

[56] S. Zagona and M. Harter, "Credibility of source and recipient's attitude: Factors in the perception and retention of information on smoking behavior", Perceptual and Motor Skills, 23(1), pp. 155-168, 1966.

[57] B. J. Fogg, G. Cuellar, and D. Danielson, "Motivating, influencing, and persuading users: An introduction to captology", Human Computer Interaction Fundamentals, pp. 109-122, 2009.

[58] T. Malone and M. Leppe, "Making learning fun: a taxonomy of intrinsic motivations for learning", In R. Snow, & M. J. Farr (eds), Aptitude, Learning and Instruction, 1987.

[59] Games for Change, from http://www.gamesforchange.org/about/ retrieved February 2017.

[60] D. Ruggiero, "The effect of a persuasive social impact game on affective learning and attitude" Computers in Human Behavior, pp. 213-221, 2015.

[61] S. Johnson, Everything Bad is Good for You: How Today's Popular Culture is Actually Making Us Smarter, Riverhead Books, 2006.

[62] C. Howland and H. Pritzker, "Extent of opinion change as a function of amount of change advocated", Journal of Abnormal and Social psychology, 54, 1957.

[63] State of Online Gaming Report 2013. Retrieved April 20, 2016, from http://www.spilgames.com/state_of_gaming_2013_uk_p1/

[64] J. P. Gee, "High Score Education", (Wired) Retrieved April 20, 2016, from http://www.wired.com/2003/05/high-score-education/

[65] F. Blumberg and S. Ismailer, "Playing Video Games Offers Learning Across Life Span", 116th Annual American Psychological Association Convention, 2008.

[66] C. Green and D. Bavelier, "Learning, attentional control, and action video games", Current Biology, vol. 22, no. 6, pp. 197-206, 2012.

[67] T. Lenoir, "All but war is simulation: The military-entertainment complex", Configurations, vol. 8, no. 3, 2000.

[68] J. Anderson-Lee, E. Fisker, V. Kosaraju, M. Wu, J. Kong, J. Lee, . . . and R. Das, "Principles for Predicting RNA Secondary Structure Design Difficulty", Journal of Molecular Biology, 428(5), pp. 748-757, 2016.

[69] L. Diab, "Studies in Social Attitudes: II. Selectivity in Mass Communication Media as a Function of Attitude—Medium Discrepancy". Journal of Social Psychology, vol. 67, no.(2), pp. 297-302, 1965.

[70] E. McGinnies and L. Rosenbaum, "A test of the selective-exposure hypothesis in persuasion", The Journal of Psychology, vol. 61, no. 2, pp. 237-240, 1965.

[71] E.S. Association, ESA Annual Report from http://www.theesa.com/about-esa/esa-annual-report/ Retrieved April 20, 2017.