

Using Video Games to Facilitate Understanding of Attention Deficit Hyperactivity Disorder: A Feasibility Study

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ABSTRACT

This paper presents an approach for facilitating understanding of Attention Deficit Hyperactivity Disorder (ADHD) through the procedural rhetoric of our persuasive video game *Drawn to Distraction*. Different from realistic simulations, our game is designed to convey a message about the disorder primarily through game mechanics. To test the feasibility of this approach, we conducted a series of studies involving caregivers of ADHD-affected children and the general public. The results, especially in Experiment 3, show promising trends on the feasibility of using persuasive games to promote understanding of psychological disorders.

Author Keywords

Game for Health; Procedural Rhetoric; Persuasive Game; ADHD Caregivers

ACM Classification Keywords

K.8.0 Personal Computing: Games

INTRODUCTION

Understanding psychological disorders can be difficult for those who are not affected by them. This is particularly true for Attention Deficit Hyperactivity Disorder (ADHD). ADHD is currently one of the most controversial psychological disorders in terms of diagnosis and validity [7], though a great deal of scientific research suggests it is a real and non-trivial disorder that may be under-diagnosed in certain populations [3]. This controversy and a related lack of understanding amongst caregivers are perhaps most impactful upon ADHD-affected children, as caregivers can strongly influence quality of life, social activity, and success in school environments [6, 11]. Furthermore, research has linked ADHD symptoms to greater parental stress, and parental stress to negative parental practices [11, 10]. To break this chain, possibly improving life quality of ADHD-affected children, it is useful to research effective strategies to facilitate understanding of ADHD, especially for caregivers.

A key challenge for caregivers is understanding the behavioral symptoms of ADHD patients from an *internal perspective*. Recent studies have shown that video games may be a promising tool for facilitating understanding through role-taking and other psychological impacts on players [2, 1, 9]. While it is possible to describe internal, psychological perspectives through media such as written text, image, and speech, video games offer a new way to involve players through interaction.

This paper presents our approach for studying how serious video games can be used to facilitate understanding of psychological disorders such as ADHD. In particular, we use Bogost's framework of *procedural rhetoric*, that is, the practice of using processes persuasively [5], in order to foster ADHD caregiver understanding. Based on research of symptoms and diagnosis, we identified a certain message (rhetoric point) about the disorder that we intended to convey. We then iteratively developed the message along with a persuasive game called *Drawn to Distraction*. To evaluate the game's effectiveness, we conducted a pilot feasibility study consisting of three experiments recruiting both caregivers of ADHD-diagnosed children and non-caregiver adults familiar with video games.

Our results showed that non-game playing populations had difficulty with our current design. Scope may have limited our ability to appeal to populations unfamiliar with video games. Game-familiar adults in both categories responded in a more intended manner, acknowledging our intent to facilitate understanding of ADHD's psychological effects through game mechanics.

In the rest of the paper, we first present our theoretical framework on procedural rhetoric and challenges of understanding ADHD. We then describe the design rationale and procedural rhetoric for *Drawn to Distraction*. Next, we present our design for the feasibility study and present our results. Finally, we conclude with suggestions for future work.

BACKGROUND AND RELATED WORK

This section presents a review of literature on the major concepts and research forming the background of our work.

The Challenge in Understanding ADHD

Misunderstanding related to ADHD may start with its title, which was created when the disorder was believed to be primarily of attention. However, research has shown ADHD to

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be a problem more of *self-regulation* [3]. Many symptoms of ADHD, such as impulsiveness or inattention, are also present in unaffected individuals, creating a commonality between the affected and unaffected. As a result, ADHD patients, who suffer from a much greater intensity of multiple symptoms over a long period of time, are often misunderstood as those who simply can't pay attention. Because of this commonality, ADHD's title, and other factors such as controversial over-diagnosis, ADHD remains misunderstood by a majority of the population [7].

This misunderstanding may cause increased negative perceptions of individuals affected by ADHD [8], leading to greater caregiver stress [12]. In turn, research has established a link between high levels of parental stress and dysfunctional parenting, including increased use of negative parental practices due to lowered perceived efficacy [11]. Dysfunctional parenting has further been linked to child underachievement [10], showing a vicious cycle for ADHD children where ADHD negatively influences caregivers, and caregiver stress can negatively influence children. On the other hand, positive perceptions of ADHD have been linked to a lessened impact of ADHD-related behavior on caregivers and positive relationships with children [12]. Hence, improving understanding of ADHD, especially amongst caregivers, may help to break the cycle and improve quality of life for each involved party.

Procedural Rhetoric

Procedural rhetoric, a term coined by Ian Bogost, describes the practice of "using processes persuasively" [5, p.28]. Compared to traditional forms of rhetoric such as speech, writing, and imagery, procedural rhetoric lends itself particularly well to making claims about *how things work* by highlighting the steps of a process through simulation. For example, Bogost analyzed Molleindustria's *The McDonald's Game* where players make difficult decisions about how to run the business. For example, will they choose to preserve rainforest but decrease availability of cow pastures? Will they bribe officials to secure profits? By letting players experience intertwined processes, the game embodies "a procedural rhetoric about the necessity of corruption in the global fast food business, and the overwhelming temptation of greed, which leads to more corruption" (p.31).

Bogost further unpacks a number of persuasive games in the domains of politics, advertising and learning. Like all rhetoric, procedural rhetoric and the video games that embody it are designed for persuasion. This makes them a potentially powerful tool to cause change in players.

Related Work

A particularly active area in the realm of representing psychological disorders through media is virtual schizophrenia simulation. In the 1980s, researchers used audio recordings to simulate auditory hallucinations. In the 1990s, head-mounted displays and 3D virtual worlds were developed to simulate visual hallucinations as well [4]. More recently, other types of simulations were created such as a multi-sensory interactive film in 2007 [13]. The intention of these simulations is to provide a greater understanding of schizophrenia for those not af-

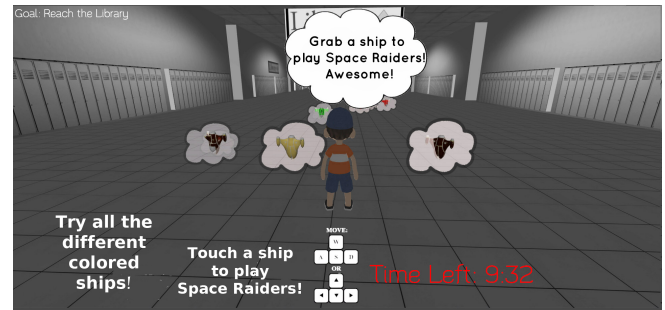


Figure 1. Distraction Objects in the Main Gameplay

ected. They can show how overwhelming schizophrenia can be, potentially increasing the level of support provided by a caregiver [13]. Compared to these approaches, we intend to focus on representing ADHD symptoms through procedural rhetoric, an *interactive process*, rather than purely audio or visual representation.

DESIGN RATIONALE

Our work aims to convey some aspects of the psychological effects of ADHD through procedural rhetoric. In other words, we intend to recreate the "feeling" of ADHD through game mechanics. In essence, we are attempting to recreate the psychological processes of ADHD through the technical processes that affect a video game player.

It is important to note that our goal is NOT to recreate a *simulation* of ADHD in a realistic and comprehensive manner. Instead, we aim to convey a specific message about the internal condition of ADHD-affected children to their caregivers and the general public. As in other forms of rhetoric, this means we may emphasize certain aspects of ADHD while down-playing certain other aspects in order to make the point clear.

Intended Procedural Rhetoric

Based on current scientific theory and understanding, some of which is described above, ADHD can result in a psychological weakening to resistance of more immediately rewarding activities while individuals attempt to complete less-stimulating tasks. For example, while completing chores such as organizing the room, children affected by ADHD may be increasingly drawn to toys within the surrounding environment [3].

Therefore we developed the following message to be conveyed through procedural rhetoric: *As a result of ADHD, affected individuals have an increased drive to engage in immediately rewarding activities, despite knowledge of their long term harm.*

It was our intent to convey the above message through gameplay, in order to facilitate players' understanding of the related real-world behavior caused by the disorder. Our primary target audience was caregivers of ADHD-affected children, such as family members. However, we would also like to use our game to broaden understanding of ADHD amongst the general public.

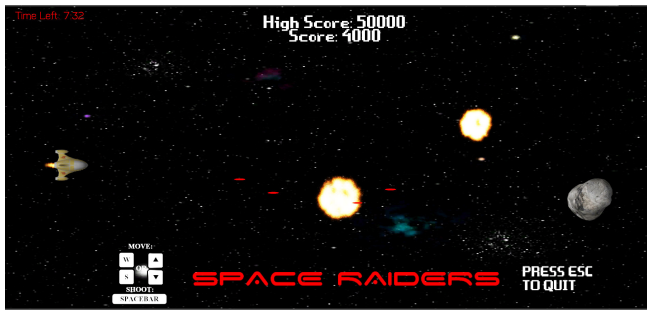


Figure 2. Mini-Game: Space Raiders



Figure 3. Distractions with a Greater Intensity

Game Design of Drawn to Distraction

We developed a third-person 3D video game called *Drawn to Distraction*. To our target audience of caregivers, we intended to convey that when children with ADHD fail to perform a seemingly simple yet unstimulating task, such as a homework assignment, the reason may be influential symptoms of ADHD rather than intentional negligence.

To convey our message, core game mechanics were designed to attract players toward options with immediate reward, despite knowledge that these actions would be harmful in the long term. In other words, we designed the game to cause frustration or mental exhaustion in our players, just as an ADHD-affected child completing a task might become frustrated or mentally exhausted due to the psychological effects of the disorder [3].

Players of *Drawn to Distraction* take on the role of a child whose goal is to reach a school library at the end of a linear, winding hallway. To win the game, the player must control the player character's (PC) movements and reach this library within 10 minutes of in-game time or he will not have enough time to study for an impending test. The player is informed by the game that he may not have enough time to study if he gets distracted along the way. Through an on-screen timer, the player can make a willful choice in how he uses his time. As our target audience may not be very familiar with computer games, we designed the control scheme to be simple, using the arrow keys and spacebar or an attached controller.

There are several elements in the game designed to gear the player toward distraction. First, we intentionally made the PC move very slowly, thus making movement toward the library a long and tedious endeavor. A key design challenge we faced was *how to make visible the condition of ADHD to people who are not affected by it*. By making this game design decision, we hoped to "translate" the mental exhaustion that children with ADHD feel into a similar reaction within ordinary players during certain tasks that may seem relatively effortless to the unaffected.

Second, we constantly create dynamic thought bubbles - narrating the PC's nagging inner thoughts - above the character (Fig. 1). These thoughts convey the PC's desire to play a game called *Space Raiders* (see Fig. 2). As the game progresses, the thought bubbles appear more frequently, making

it increasingly difficult to stick to the main goal and avoid thinking about in-game distractions (details below).

Third, the main distractions in the game are manifested as miniature spaceships that appear out of thin air, filling up the area in which the player has to move. As the PC moves further through the hallway, these spaceships also appear more frequently. Once the PC touches one of them, the player is transported into a mini-game called *Space Raiders*, a favorite of the PC. In it, the player earns a separate score by shooting incoming asteroids. In contrast to the bland appearance and slow pace of the main game goal (within the hallway), *Space Raiders* is designed to be colorful, fast and more engaging. *Space Raiders* offers the player an immediately rewarding activity but distracts from the main goal of reaching the library. The player leaves the mini-game by being hit by an asteroid or by pressing the ESC key, resetting the *Space Raiders* score.

In addition, playing *Space Raiders* causes *Drawn to Distraction*'s main timer to tick down much faster than normal. Although we leave the timer visible throughout the mini-game, we did not stress this fact. This design decision was made to echo how an ADHD-affected child affected can easily lose track of time and fail a task due to distraction.

Therefore, the *conflict* in *Drawn to Distraction* is between short-term and long-term reward. The only way to win the game is to move to the library and avoid touching distractions for around 6-7 minutes, a relatively long time for an unstimulating task. As mentioned earlier, distractions become harder to avoid over time. This in-game conflict is designed to mirror the real-world conflict faced by ADHD-affected individuals while completing tasks that are not immediately rewarding.

Drawn to Distraction has two outcomes. The player can reach the library before the timer runs out and the PC receives an A grade on his test. Alternatively, when time is up, the game will immediately end with a poor grade of D+. Both outcomes were intended to cause frustration in the player. In the former case, the player likely endured a lengthy and unstimulating experience. In the latter case, he will likely become frustrated from failure, especially if he was only distracted for a short time. These outcomes could potentially express the psychological feelings that ADHD-affected children face in their everyday lives.

Through the above game mechanics, we intend to convey the message "As a result of ADHD, affected individuals have an

No.	Question
1	<i>In your opinion, how aware are ADHD-diagnosed individuals in terms of how ADHD affects their actions?</i>
2	<i>How well do you feel you understand the effect that ADHD has on an individual?</i>
3	<i>How much do you feel ADHD changes an individual's day-to-day decision-making process?</i>
4	<i>How much ability does an individual affected by ADHD have to change their own behavior patterns?</i>
5*	<i>How personally do you take it when the individual under your care does not respond to an immediate request (i.e. does not immediately complete chores, homework, etc.)?</i>
6	<i>How effective do you think a video game could be at expressing a message to the player and fostering his/her understanding of real world issues?</i>

Table 1. Survey Questions Used in Experiment 1 & 2 (*Question 5 only used in Experiment)

Question	M		SD		t(6)	p
	Pre	Post	Pre	Post		
1	4.86	5.14	1.86	1.95	-0.795	0.457
2	5.00	4.71	2.08	2.36	1.000	0.356
3	5.71	5.29	1.25	1.38	1.441	0.200
4	4.86	5.00	1.57	2.08	-0.311	0.766
5	4.72	5.43	1.80	1.51	-1.000	0.356
6	5.86	5.00	1.07	1.41	1.867	0.111

Table 2. Mean and Standard Deviation on Questionnaire from Caregivers in Experiment 1.

increased drive to engage in immediately rewarding activities, despite knowledge of their long term harm."

EXPERIMENT 1

We designed a series of experiments to 1) test how effectively our procedural rhetoric conveyed the intended message and 2) to collect preliminary data related to the use of procedural rhetoric to facilitate understanding of psychological disorders. More specifically, our hypothesis is that *after playing our game, participants will change their understanding of ADHD and will think favorably of our approach.*

Participants

The first experiment group consisted of caregivers of individuals affected by ADHD (N = 7). Seven caregivers were recruited through a Philadelphia-area psychologist as volunteers and were not compensated financially. The participants' ages ranged from 21 to 33, with an average age of 27.5. Amongst them, one participant spent 15+ hrs/week playing video games, and a second participant 3-6 hrs/week. The remaining 5 participants had no video game experience.

Procedure

After a short demographic survey, participants answered six questions on a 7-point Likert scale (Pre), in which 1 represented the most negative end of answers such as "zero understanding" or "zero effectiveness" and 7 represented the most positive end. Next, participants played *Drawn to Distraction* under the observation of an investigator. Once a participant finished the game with either outcome (i.e. reached the library or time ran out), she then completed the same six questions given previously to measure change in attitude and understanding (Post). These questions, which focus on understanding of ADHD aspects, are given in Table 1.

Results

Table 2 summarizes the results of pair-wise t-tests on the Pre and Post answers of the questionnaires from participants. Our

hope was that there would be meaningful change in their answers after having played *Drawn to Distraction*. Unfortunately, as can be seen, none of the changes from Pre to Post were significant at alpha level 0.05.

One critical issue that we believe led to the lack of positive results in Experiment 1 was how most caregiver participants had little to no experience with video games. Only one participant, whom had most video game experience, reached the game's successful outcome. All other participants ran out of time, some within the distraction mini-game, and others by playing the distraction game for too long. No participant quit before reaching either outcome, but some participants exhibited confusion in what they were supposed to do within the game despite on-screen text explanations. We believe that in order for our message to be expressed, the player may need a certain level of familiarity with how video games generally work. This issue led us to carry out Experiment 2 with a population that was more familiar with and experienced in playing video games.

EXPERIMENT 2

To address lack of video game experience as a potential obstacle to *Drawn to Distraction's* procedural rhetoric in Experiment 1, we carried out a second experiment using the exact same procedure as the first but with a participant group more familiar and experienced with video games.

Participants

The second experiment consisted of thirteen undergraduate students recruited from the Digital Media Program at Drexel University. Within this group, all but two of the participants knew a family member or friend diagnosed with ADHD. All participants had significant exposure to video games, with video game playing time averaging 3-6 hours per week. Their average age was 19.8.

Procedure

The procedure in Experiment 2 followed the exact procedure as Experiment 1. However, we removed question 5 from the pre/post questionnaire because it was designed for caregivers and did not apply to this population.

Results

Table 3 lists the results of the pair-wise t-tests on the Pre and Post answers of the questionnaires from participants. Because question 5 was not given, it is missing from the table. We preserved question numbering to mirror Table 2 for ease of

Question	M		SD		t(12)	p
	Pre	Post	Pre	Post		
1	4.15	4.31	1.57	1.25	-0.485	0.636
2	3.85	4.31	1.57	1.03	-1.032	0.323
3	4.77	4.69	1.09	0.95	0.433	0.673
4	3.62	4.15	1.33	1.35	-1.849	0.089*
6	5.92	5.69	0.06	0.95	0.898	0.387

Table 3. Mean and Standard Deviation on Questionnaire from Students in Experiment 2.

comparison. As can be seen, none of the changes from pre to post were significant at alpha level 0.05.

However, we do see a hint of a positive change at least in one of the questions. At $p < 0.1$, question 4 shows moderate significance at $p = 0.089$, suggesting that after having played the game, participants were more likely to believe that an individual with ADHD had the ability to change their behavior.

ANALYSIS AND DISCUSSION

Our quantitative results from Experiment 1 and 2 are inconclusive. However, qualitative results from both experiments seem to support that we at least partially succeeded in conveying our message through procedural rhetoric. The open-ended comments in both experiments acknowledged that *Drawn to Distraction* was meant to send a message, and players from both groups (though primarily the non-caregiver group) understood that message. In some comments related to our game design, participants pointed out that the message about ADHD was derived from a comparison between an unstimulating main goal to a more stimulating distraction mini-game, which aligned with our intent.

Lack of video game experience appeared to be an immediate and significant factor for our caregiver participants. Some caregivers appeared confused about on-screen prompts and the game's main goal. We believe that this lack of experience significantly affected their responses. For the two caregiver participants with video game experience, including the only one who completed the game, both responded very favorably in terms of enjoyment.

In their open-ended comments, one participant suggested that the game should be "more comprehensive" because she "felt like [she] was lost." Another participant liked that there was a goal involved for the player. A third participant said she enjoyed how the game was a challenge for her as someone diagnosed with ADHD herself. We believe that this is an indication that our game had some success in capturing the psychological effects of ADHD.

In contrast, our non-caregiver student participants were familiar with games and responded well to the procedural rhetoric of our game. They expressed that it was interesting to turn a psychological problem into a physical one, and the game made them think about ADHD in a new way. They all indicated an understanding of the game's main goal without verbal explanation from researchers. However, this experience also turned out to be partially detrimental to our procedural rhetoric. Multiple students responded that they found distractions unappealing because they knew these objects would cause failure. Some of them also said they wished we could

make our point in less time, and that there should be more fun activities besides the *Space Raiders* mini-game. One student even said that as a game player he tends to go against direction, so guidance toward distraction had the opposite effect. There appears to be a fine line between directing certain video game players toward an action and pushing them away from it entirely.

We noted that most participants believed ADHD to be a disorder primarily affecting focus and attention before engaging in our study. Because our game focuses on these common symptoms, it makes it more difficult to fully assess the effect of our approach. Still, a game such as *Drawn to Distraction* may have a place in attempting to replicate the feeling of already understood notions for greater empathy.

Additionally, most of our main questionnaire items may not have been appropriate for our specific purpose, as they were focused on general understanding of ADHD concepts. On the contrary, we wanted to send a message about a very specific aspect of ADHD. We believe our questionnaire items should have been focused more intently on the concept of our procedural rhetoric. This led us to Experiment 3.

EXPERIMENT 3

In this experiment, we sought to address our concerns with previous questionnaires. We revised our questions to focus more closely on the intended procedural rhetoric.

Participants

In this experiment, we recruited eight undergraduate and graduate Computer Science students at Drexel University ranging in age from 20 to 29, with an average age of 23.0. They all have substantial previous video game experience.

Procedure

The procedure followed the exact procedure as Experiments 1 and 2, but with a revised questionnaire as provided in Table 4. The responses also use a 7-point Likert scale, ranging from "entirely disagree" (1) to "entirely agree" (7).

Results

Table 5 lists the results of the pair-wise t-tests on questionnaire answers from pre and post. As can be seen, questions (1), (3), and (6) were found to be significant at alpha level $= 0.05$. First, this indicates that our concern about question quality was valid, and second, we feel that it also shows *Drawn to Distraction* successfully conveyed the intended procedural rhetoric to participants. In addition, question 7, while not significant at alpha level 0.05, is moderately significant at $p < 0.1$, at least hinting that participants believed video games could be effective at facilitating understanding of psychological disorders. In addition, it is notable that questions (1), (3), and (6), those in which we found significant change, were questions dealing with empathy for people affected by ADHD. This was significant in that the core procedural rhetoric of *Drawn to Distraction* was designed to increase player empathy/understanding of people affected by ADHD.

No.	Question
1	<i>I understand what it feels like to be affected by ADHD.</i>
2	<i>I understand the behavior exhibited by those affected by ADHD.</i>
3	<i>I understand the frustration that can be felt by those affected by ADHD.</i>
4	<i>I feel it is more challenging for ADHD-affected individuals to complete long-term goals.</i>
5	<i>I understand why ADHD-affected individuals might neglect long-term goals in favor of more immediately rewarding actions.</i>
6	<i>I understand the impact that ADHD has on an individual's time management skills.</i>
7	<i>I feel a video game can be effective at increasing understanding of psychological disorders.</i>

Table 4. Survey Questions Used in Experiment 3

Question	M		SD		t(7)	p
	Pre	Post	Pre	Post		
1	3.00	4.25	1.20	1.04	-2.546	0.038**
2	4.50	4.75	0.76	1.04	-0.798	0.451
3	4.75	5.63	0.89	0.92	-2.497	0.041**
4	5.00	5.13	1.41	1.25	-0.552	0.598
5	5.25	5.00	0.71	1.07	0.798	0.451
6	5.00	5.50	1.20	0.93	-2.646	0.033**
7	5.25	6.00	1.49	0.93	-2.049	0.08*

Table 5. Mean and Standard Deviation on Questionnaire from Students in Experiment 3.

CONCLUSION AND FUTURE WORK

We designed and developed *Drawn to Distraction*, a serious game that uses procedural rhetoric to facilitate understanding of ADHD. Instead of a realistic simulation of the disorder, as in many related projects, our game was designed to convey a message through gameplay. To test our approach, we conducted a series of studies on two populations. The results, especially Experiment 3, show promising trends on the feasibility of using persuasive games to promote understanding of psychological disorders.

There were multiple limitations of our studies. First, due to small sample size, our study does not offer conclusive evidence. In future work, we intend to recruit a larger number of participants. Second, our questionnaires used in Experiments 1 and 2 focused too heavily on general, factual-knowledge about ADHD. However, as indicated by the results of Experiment 3, a revised questionnaire that focused on empathy showed great promise. For future studies, we suggest using a more empathy-based instrument.

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