

# “Bully”: A Virtual Reality Environment for Anti-Bullying Education

**Lubomir Ivanov**

Computer Science Department, Iona College  
New Rochelle, NY, 10801, USA  
livanov@iona.edu

**Nina Ramos**

Computer Science Department, Iona College  
New Rochelle, NY, 10801, USA  
goninar@gmail.com

## Abstract

We present an early prototype of a virtual reality environment, intended to teach pre-teenage children how to deal with bullying situations. The environment consists of several scenes where the participant needs to resolve a bullying conflict. The simulation is based on short dialogs between the bully and the participant. We employ natural language processing to accept the participant’s verbal responses to the bully’s taunts and use these responses to drive the simulation. The participant is expected to determine on his/her own the correct approach to resolving the bullying situation.

## 1. Introduction

Bullying is an ever-growing societal problem that affects people of all ages. Bullying manifests itself in different forms – from verbal to physical to psychological. It is based on a number of factors such as age, gender, race, national origin, and later, on sexual orientation. Bullying can be classified as direct or indirect (Bijttebier and Vertommen 2017). Direct bullying is confrontational and can vary from verbal to physical. Indirect bullying involves spreading hurtful rumors and lies about a person, character assassination, ostracizing and isolation. In young (pre-teenage) children, bullying is usually direct, while in older children and adults bullying manifests itself in both a direct and an indirect form.

Bullying stems from a perceived or real imbalance of power between individuals in a social setting as well as from deeply ingrained psychological issues in both the bully and the victim. Psychological studies have found that bullies tend to be more aggressive, impulsive, and have little empathy for others. According to Dan Olweus, bullies’ “aggressive reaction patterns are formed around their desire for power and dominance over their peers” (Olweus 2017). Victims, on the other hand, often tend to be insecure, sensitive, and quiet. Some studies indicate that the internalized shame of being a childhood bullying victim can lead to an increased

probability of being a victim later in life (Pontzer 2017). To combat bullying, it is imperative for any intervention to occur in childhood, while the psychological elements of bullying or victimization have not yet been internalized.

One way to address bullying is to teach children ways to recognize and deal with bullying situations. Outside the traditional psychological approaches, the software community has been very active in attempting to find solutions to bullying. There are numerous websites and mobile applications dedicated to educating the public about the dangers of bullying. Some applications, such as the BRIM Anti-Bullying Software (BRIM), provide a mechanism to report instances of bullying through a mobile interface. In (UR), a non-interactive virtual reality (VR) system projects VR movies, placing the participant in bullying situations. In (Stavroulia et al. 2016), the authors present a virtual reality application to train educators to recognize bullying in middle school. Another VR anti-bullying environment is the Amanda Project. Named for a young person who committed suicide as a result of bullying, the project offers a set of virtual/augmented reality (VR/AR) tools for anti-bullying education.

In this paper, we present an early prototype of a complex VR environment, “Bully”, aimed at educating young children (ages 6-10) to deal with bullying in different social settings. Unlike other software approaches, our system is fully interactive and provides the participant with a complete freedom of speech and action in order to create a more immersive experience closely resembling real life. The system uses natural language processing (NLP) to allow the user a realistic, natural interaction with the simulation. Following the best practices and recommendations from Psychology, we aim our VR system at pre-teens in the hope that the lessons learned will be internalized at an early age, reducing the impulses to engage in bullying later in life and learning to recognize and deal with bullying situations if they arise.

## 2. “Bully” Architecture

“Bully” is an immersive 3D virtual world, where the participant is faced with bullying situations, which he/she needs to resolve independently. Feedback is offered at the conclusion of each interactive session. The goal is to make the interaction as immersive and close to real-life as possible, yet provide an educational component to help guide the young participant toward a successful resolution of a conflict.

The system is aimed at pre-teens (kindergarten through 3<sup>rd</sup> grade). Numerous psychological studies have demonstrated that early intervention allows the anti-bullying message to become internalized and certain psychological traits to be ingrained in the child’s personality. These traits restrain him/her from engaging in bullying and allow him/her to be more resistant to bullying and its effects. The initial prototype of “Bully” is specifically intended for young girls, who are more prone to being victims of verbal rather than physical bullying. Thus, the participant – a young girl - will be engaged in a dialog by a bully (also a girl) with “physical” interaction limited only to the bully blocking the participant’s path. We do include a “physical fight” option, but it is always initiated by the participant, never by the bully.

### 2.1 Scenes and Characters

At present, the system consists of two interactive scenes:

*School Corridor Scene:* In this scene, the student is trying to get to class, but her path is blocked by another girl – a bully (Fig.1). The bully does not restrain the movement of the participant other than to prevent her from reaching her intended goal. The participant can seek an alternate path. The scene includes student bystanders, who respond to the participant-bully exchange with laughter or short comments. The scene also includes a teacher, whom the participant can turn to for help or who can step in if the conflict escalates.



Fig.1 A bully blocking the path of the participant

*Playground Scene:* The setting in this scene is a playground between residential buildings. The playground has children playing on swings, slides, and in sandbox. Among

the children is the bully (Fig.2). As the participant enters the playground, the bully moves to confront her, blocking her way to the playground and engaging her in a bullying dialog. The scene includes bystanders who side either with the participant or the bully depending on the state of the dialog. Additionally, there are a few adults, who observe the children playing, but can step in to prevent a physical escalation.



Fig.2 A bully confronts the participant at the playground.

In addition to the main interactive scenes, there are semi-interactive scenes displayed at the end of each scenario:

*The Principal’s Office:* This scene is displayed if the participant decides to engage in a “physical” fight with the bully during the confrontation at school. The principal addresses the participant and the bully, explaining that violence does not resolve conflicts and may lead to more violence. This scene is semi-interactive: The participant stays in place but can look around, including at the bully.



Fig.3 In the school principal’s office.

*The Livingroom Scene:* This scene is displayed if the participant engages in a “physical” confrontation at the playground or decides to tell her parents about the bullying. In first case, the parents tell the child that violence does not resolve conflicts. In the second case, the parents reassure the child and explain that the best ways to handle a bully are to walk away, ignore the bully, or talk things over. The participant can pace around the room but needs to periodically look up at the parents or she will be asked to pay attention.

*The Successful/Unsuccessful Resolution Scenes:* These are static scenes, which either congratulate the participant or provide suggestions for improvement.

## 2.2 Scenes Implementation

The “Bully” virtual environment was created using the Unity game engine. The scenes were implemented with pre-fabs obtained from the (Unity asset store) or constructed by us. The voices of the bullies and the bystanders were recorded by the researchers and the background noises for the interactive scenes were obtained from (Sound Bible).

The bully interaction is triggered by the participant walking into a collider placed on the bully object, which triggers the dialog system described in section 2.3. The dialog system controls the behavior of the bully, the bystanders, and the adults (teacher, parents, principal), the progress of the dialog, and scene transitions. The VR aspects of the game are implemented with custom C# scripts for the Oculus Rift, partially based on Unity’s OVR system. Both Oculus Rift and Touch are supported, with Oculus Touch being used to simulate a “physical” fight. The microphone inside the Rift helmet is used to interface with the NLP system.

## 2.3 The Dialog System

The “Bully” dialog system is one of the focal components of this research project. Creating the dialog system required a close collaboration with colleagues from Psychology who advised us on the appropriateness of the specific dialog choices. Bullying is a complex, multifaceted, and dynamic topic: Many, sometimes conflicting theories about how to properly handle bullying exist. It is of paramount importance to select an optimal set of dialog elements which balance realism and educational experience while protecting the participant from the stress and fear of real-life bullying. To achieve this our dialog system keeps the conversations short: Six to eight sentences are exchanged between the bully and the participant to ensure that the stress level remains low and the exchange does not become too “heated”.

For each scene, the dialog system implements a ternary tree. Each node represents a dialog state, which consists of:

- Bully statement (e.g. taunt, insult, etc.)
- A set of three possible user responses.
- Bystanders filler speech (e.g. taunts, laughter, etc.)

Starting at the root of the tree, the system drills down in response to user vocal input until it reaches a leaf node, representing an outcome of the interaction. The dialog is initiated by playing the bully’s statement in the root node. The participant has to respond by selecting one of three possible options, which can be read verbatim or inferred by the NLP system described in section 2.4. The three participant responses are carefully crafted: One option is designed to escalate the conflict. The second option is a neutral statement. The third option is the optimal response. For example:

*Bully:* “Oh, you think you are so smart...”  
*Participant:* Option 1: “Smarter than you!”  
Option 2: “I’m gonna tell the teacher”  
Option 3: “Just let me through, please.”

In the example above, option 1 clearly leads to further escalation. Option 2 is a viable option since asking an adult for help will likely bring an end to the bullying incident. Some psychologists recommend this as the most appropriate course of action. However, calling the teacher does not prevent further instances of bullying and may exacerbate the situation: The bully may back away but reengage at a time when no adults are present. Option 3 is the optimal choice: The participant remains polite and emotionally unaffected.

The bystanders play an important role in the dialog. Bullies usually crave the attention and adoration of others. Often, acts of bullying are perpetrated publicly, in front of the bully’s cronies. That raises the level of stress, embarrassment and humiliation of the victim even further. In the above example, the giggling of the bystanders in response to options 1 or 2 further encourages the bully. If the participant chooses option 3, the bystanders mutter a noncommittal “mmm”, which helps de-escalate the confrontation.

As indicated earlier, the depth of our dialog trees is limited to no more than 4 levels in order to avoid raising the stress level of the participants, but also in order to decrease the complexity and scale of the system. A full ternary tree of height  $h$  has a total of  $(3^{h+1} - 1)/2$  nodes. Even with  $h=4$ , the number of tree nodes (simulation states) is 121. Since we have two interactive scenes (for now), the total number of bully audio prompts which must be recorded is 242 not including the audio for the various bystander comments. Some audio files can be reused but there has to be a substantial variety in the bully’s speech in order to maintain the realism of the bullying scenarios. Additionally, audio must be recorded for all leaf nodes – the school principal’s office scene, the living room scene, and the success and failure scenes.

## 2.4 The Natural Language Processing System

The NLP system is one of the most important aspects of the “Bully” environment. It is essential for creating realism in the simulation and for providing a completely natural exchange between the virtual bully and the human participant.

The NLP system operates in one of two modes: In *simple interaction mode*, given a particular state of the dialog, the three possible user responses are displayed as text labels in a Unity UI interface (in world space render mode). The user is expected to read aloud the text of the chosen option. The user’s spoken input is captured and converted to text by a speech-to-text system. The captured text is then compared to the three options in the current state of the dialog tree through a simple syntactic string comparison algorithm, and the matching option (if one exists) is selected.

In *realistic interaction mode*, the user’s spoken input is captured and converted to text but this time it is compared to the three options in the current state of the dialog tree using a semantic similarity algorithm. The semantic comparison is based on our implementation of the methodology in

(Dao and Simpson 2002). It involves a number of steps including parsing the text, stemming the words, part-of-speech (PoS) tagging, word sense disambiguation, and calculating inter-sentence distance based on a similarity matrix constructed from information obtained from the Wordnet lexical database (Wordnet, Fellbaum 1998, Miller 1995) using the C#-based Wordnet.net library (Simpson and Crowe 2005). The algorithm selects the built-in option closest semantically to what was said by the user.

Afterwards, the associated bystanders' filler sounds are played, and the state of the simulation is transitioned according to the transition structure of the dialog ternary tree.

### 3. Future work

The number of directions for future work is virtually unlimited: "Bully" is currently in an early prototype stage and is aimed specifically at pre-teenage girls. A natural next step will be to expand the system to include anti-bullying training for pre-teenage boys. Bullying, in the case of young boys, often involves not only a verbal but a physical aspect. To properly implement anti-bullying training for boys we will have to develop animation sequences involving physical bullying. This will necessitate the development of a different participant response system, possibly including standing up to the bully. This is tricky: Most psychologists recommend that fighting back should be avoided in almost all but the direst of circumstances in order to prevent a dangerous escalation of violence. There are, however, cases where self-defence against violent physical assault is necessary. We will have to work with psychologist and criminal justice experts to determine the exact circumstances in which self-defence may be appropriate.

An entirely different development direction will be to explore the role of the bystander. Instead of placing the participant in the role of the victim, we can allow them to opt to play a witness to a bullying situation. The participant's choices will be designed to affect the outcome of the situation: If the participant sides with the bully, the level of bullying will escalate, and the simulated victim will be humiliated. If the participant opts to side with the victim, then bully will back off, and the conflict will be resolved successfully. Once again, the implementation can be tricky both from a technical and from a psychological point of view: Sometimes, if a bystander sides with a victim, the bully may become enraged and attack both the victim and the bystander. It is important to implement the bystander dialog options carefully, so as to teach children proper techniques for de-escalating the bullying situation.

Another natural expansion of the project is to include more sophisticated dialog scenarios and an improved NLP system using machine learning to improve the semantic matching of the user's responses to the built-in options.

Finally, we are in the process of implementing more realistic 3D models of the simulation characters, which include gestures, facial expressions, and mouth movement that matches the character's speech. However, while realism is essential, photo-realism may be detrimental: It can significantly raise the anxiety levels of the participants, defeating the intended purpose of the anti-bullying training session.

### 4. Conclusion

We have presented an early prototype of a virtual environment, "Bully", for anti-bullying training of pre-teenage children. The system is a result of a close collaboration between computer scientists and psychologists and implements multiple anti-bullying training scenarios using a complex dialog system and a built-in system for natural language understanding. We believe that, once deployed, the system will prove vital in training young children to recognize and effectively deal with bullying. More importantly, the ultimate goal of the system is to instill in children certain moral qualities and personality traits, which will compel them to make the right choices and never engage in bullying as children and, later in life, as adults.

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