Modelling Social Network Interactions in Games

Edgar Cebolledo and Olga De Troyer

WISE

Department of Computer Science

Vrije Universiteit Brussel

Pleinlaan 2 1050, Brussels Belgium
ecebolle@vub.ac.be and Olga.DeTroyer@vub.ac.be

Abstract

Social Networks, like Facebook, have become an important part of life for millions of people, with many people using them on a daily basis. While there are games that simulate life-to-life interactions, there are not as many that simulate social network interactions, and even fewer where social network interactions are an important part of the gameplay. Having models for the simulation of interactions on social networks is the first step needed to be able to create games where a social network is an important component of the gameplay. In this paper we present a model to create dynamic and believable interactions in social networks and indicate how it was used in a serious game about cyberbullying. The model is based on personality models and Berne's so-called Social Games.

1 Introduction

Social Networks are part of the daily lives of millions of people. Facebook reports 1.44 billion monthly active users as of March 31, 2015 (Facebook 2015). People share all kind of information in social networks, from what they ate to where they are. Currently there are many well-known social networks. While some are of general use, like Facebook or Google Plus, there are more specialized ones like Instagram for pictures, or Tinder for meeting people, or Foursquare to indicate where people are.

As games tend to use environments that are based on real life environments, social networks have also started to appear in games. So far, simulated social networks have been used in single player games, mostly to communicate information of the Non Playable Characters (NPCs) to the players like in Prom Week (McCoy 2012) or Tiny Tower (Mobage 2013). To the best of our knowledge, RedShirt (Games 2013) is currently the only game that incorporates a simulated social network as an important part of the gameplay. However, incorporating social interactions may quickly become important as social networks are an integral part of our life and start to replace other types of communication (e.g. letters, phone calls, some face-to-face communication), which one would like to see reflected in games.

For this reason, it is important to be able to simulate social network interactions. Moreover, we want to have believable simulations. Models that can be used for simulating believable social face-to-face interactions do exist, e.g. (Berne 2010). However, as far as we are aware of there are no models for simulating believable interactions in social networks. Models for regular (face-to-face) social interaction cannot be used as such for social network interactions because social network interactions have some fundamental differences:

(1) In a social network, the interactions may not have an explicit ending. Sometimes a person can start an interaction, and only get a response a few days or months after it was originally started, if a response is given at all. Also, sometimes people start interactions in social networks and no one replies.

(2) Social interactions in social networks are less focussed than face-to-face ones. In social network interactions, it is common to change topic or to create subtopics, and in several occasions, the original interaction is never resumed. This is rather uncommon in face-to-face interactions.

(3) In a social network, people can explicitly "like" something, a dialog, an image, an interaction, anything. This has no direct equivalent in face-to-face interactions (although people can express their opinion about something by saying).

Dialog trees, which have been used for years to model interactions in games (see Figure 1 for an example), are too limited. They restrict the interaction to a few options, and expanding the number of options makes the tree grow
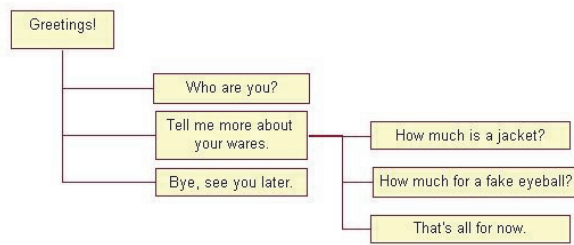
Figure 1.   Dialog Tree Example (Adventure Game Studio 2014)

Figure 2.   Reiss' 16 basic desires (Strategic Sinergy 2010)

quickly. Another problem is that, in order to have unique NPCs, each NPC requires its own dialog tree, so if one interaction were used in a few NPCs, changing it would require changing all the dialog trees with the same interaction. In addition, adding a new event in the game requires rewriting parts of the tree of every NPC that is affected by the new event. Dialog trees are a good option for linear games, i.e. games without (or with a minimum of) different options or paths, but for dynamic (i.e. not prescripted) interactions like the ones we need for believable social networks, they are not suitable.

In order to simulate a believable social network, each NPC needs to be unique, with its own preferred interactions and dialogs. They should also be able to decide when to start or continue an interaction.

In this paper, we propose a model for simulating dynamic believable interactions in social networks. It is based on the use of personality models for NPCs, which allows for unique NPCs having motivations for their interactions. To support dynamic interactions, we use an approach based on Eric Berne's Social Games (Berne 2010) but adapted it towards social network interactions.

The paper is organized as follows. Section 2 discusses related work. Section 3 discusses the use of a personality model and section 4 discusses Eric Berne's Social Games model and its shortcomings for modelling interactions in social networks. In section 5 we present our model for social network interactions. Section 6 discuss its application in BullyBook, a single player game designed to teach teenagers about identifying cyberbully situations, learn the consequences of cyberbullying, how to cope with it, and stand up for victims. Section 7 concludes the paper.

2 Related Work

RedShirt (Games 2013) is a sci-fi parody game about social networking inside a space station. The core of the gameplay are the social interactions using Spacebook, a parody of Facebook. The player can see posts made by NPCs, like their status, and interact with them in order to get a promotion or make someone fall in love. The player's avatar has interests based on the activities performed, and NPCs respond differently based on these activities. To the best of our knowledge there are no publications explaining the model they used, so we cannot compare it nor use it as a base for our work.

The Sims 3 is heavily based on social interaction (although not in the context of social networks). Sims 3 takes a different approach compared to other games with social interactions. The player does not decide what to say or how to respond, instead, the AI of the game decides the outcome of the interactions based on the personality and current status of the participants. Another difference with other games that include social interactions is that there are no dialogs. The player or NPC selects the intention (flirting, seducing, friendly talk, etc.), and the interaction is expressed with symbols instead of text, without input from the player. The Sims 3 does not have a model for interactions. Interactions are simply started based on the player or the NPC's needs.

SimBully (Cebolledo and De Troyer 2014) and Prom Week (McCoy 2012) also use Eric Berne's Transactional Analysis (TA) (Berne 2010) as a basis for their interactions model. The difference with the work in this paper is discussed in section 4. Also Façade has an interesting system for interactions and narrative, but those interactions are for face-to-face communication and not for social networks (Mateas 2003).

3 Personality Models

To come to believable simulations of social interactions, we propose to give NPCs a unique personality. This personality will give them unique motivations for their interactions, which will improve the believability.
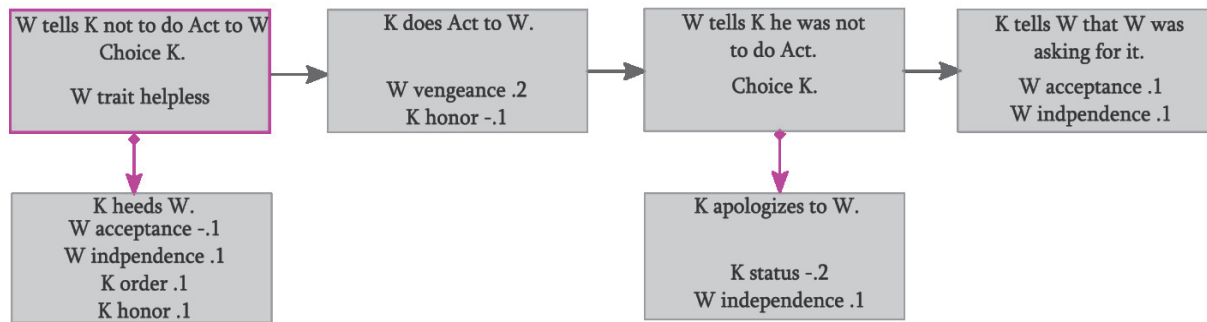
| W tells K not to do Act to W Choice K. W trait helpless | → | K does Act to W. W vengeance .2 K honor -.1 | → | W tells K he was not to do Act. Choice K. | → | K tells W that W was asking for it. W acceptance .1 W indpendence .1 |
| K heeds W. W acceptance -.1 W indpendence .1 K order .1 K honor .1 | | | | K apologizes to W. K status -.2 W independence .1 | |

Figure 3. Eric Berne Social Game representation in Prom Week (McCoy and Mateas and Wadrip-Fruin 2009)

There exist a few personality models. The most widely used is the Big Five Model (Goldberg 1990). This model consists of five groups that encompass the types of personality. Raymond B. Catell examined the English words to describe personality traits, and created 171 bipolar dimensions from a set of 18k adjectives, which were classified into 35 groups of related terms, which were reduced to 12 personality factors. After reanalysing Catell's variables, Tupes and Christal (Tupes & Christal 1961) found "five relatively strong and recurrent factors" and the results have been replicated by other researchers. These Big Five factors are: Extroversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience.

In the Big Five Model each person has a score for each of the 5 traits (this could be measured using, for instance, a questionnaire). Although this personality model has been well accepted, it has also received criticism. For instance, Paunonen and Jackson (2000) argue that there are more than five dimensions of personality. They mention 9 clusters that, although some of them are not orthogonal, are important to understand human behaviour.

Steven Reiss (Reiss 2001) proposed a model that includes 16 basic desires (see Figure 2) that each person has, but with different intensities. For example: a person with a high desire for *Eating* is more prone to pay for gourmet food, compared to a person with a low desire for this basic desire (and is less prone to pay for gourmet food or to go to restaurants). The intensities of the desires remain stable during the adulthood of a person, but the current needs do change with time. As time passes by, a person will feel the need to eat. How often a person will feel the need to eat is dependent on his intensity for the desire *Eating*. So, if a person with a low *Eating* desire does not satisfies his need in a long time, that person may go to a restaurant or get food anyhow to satisfy his eating need.

iATTAC (Cebolledo and De Troyer 2015) and Prom Week use Reiss' profile for NPCs, while other projects like Storybricks (Namaste 2010) use the Big Five Model. The Sims 3 (Maxis 2009) has believable NPCs where each one has 5 simple personality traits (out of a pool of 80). While some traits can be easily mapped to the Big Five, others are not. This illustrates that different personality models can be used in games. Therefore, we don't prescribe the use of a particular model. Which one is most suitable depends on the game itself, but for our use it is important that the model is composed of atomic units that can be reused among NPCs.

4 Eric Berne's Social Games

In Transactional Analysis (TA) (Berne 2010), Eric Berne defines the concept of a *stroke*, i.e. "a fundamental unit of social action", and so-called *social games*, i.e. "a game is an on-going series of complementary ulterior transactions progressing to a well-defined, predictable outcome". Each such social game has a list of roles (some can be optional), a series of strokes, and a *payoff*, i.e. a social benefit for each participant based on the role he/she played. If the social game is interrupted or does not finish as expected (for example if a person does not play the expected role) there is no payoff for the participants. TA is an approach to model regular (face-to-face) social games. To avoid confusion with games played inside a social network (which are also called social games), we will refer to Eric Berne's Social Games by means of EBSG.

An example of an EBSG is "If it weren't for you" (IWFY). In this game, there are two participants. We will illustrate this EBSG with the example of Mr. and Ms. White. Ms. White complains that her husband restricts her activities, so that she never learned to dance. However, after treatment, the husband becomes more indulgent and allows her to go to lessons. After she enrolled for the lessons, she finds out that she has a morbid fear of dance floors and has to abandon the project. Ms. White had chosen a dominant man as husband, so he would limit her, and she could complain to her friends playing "If it weren't for him" (IWFH). But contrary to her complaints, he was protecting her by forbidding her things she was scared of.

In this example each participant has a payoff, the hus-

band keeps the role of a domineering husband, and the wife is safe from fears while allowing her to play IWFH with her friends. As all games, a Social Game (EBSG) comes to an end when a participant decides to stop playing. If Mr. White allows her to do what she wants, then she is forced to face her fears, and could no longer play IWFY, and he would lose his dominant position.

SimBully (Cebolledo and De Troyer 2014) and Prom Week (McCoy 2012) also use EBSG as a basis for their interactions model. In Figure 3 there is an example of an EBSG used in Prom Week. The structure of the EBSG forces the type of dialog that can be used. In this example of the EBSG "Kick me", there are two participants: White (W) and the Kicker (K). The EBSG begins when W tells K not to do 'Act' to W. At this point, K has two options, to accept the request or to do Act. If K does Act, then W will tell K he was not supposed to do Act. Then K can apologize or reply back that W was asking for it. In each step of this social game, there is a payoff to the NPCs, for example, when K apologizes to W, K's 'status' decreases by .2 and W's 'independence' increases by .1.

SimBully, a simulator about bullying in a school, also uses EBSG, but it uses a slightly different model. In SimBully, an EBSG can start when another EBSG is being played, in which case the new one will replace the previous one. This is used to be able to create bullying situations, where it is desirable to be able to have people reacting to the bully or supporting the victim. With the SimBully approach, it is indeed possible to have an EBSG for a bullying situation that can be interrupted by an EBSG where someone stands up for the victim.

Although, Berne's model of social games is an adequate model, it cannot be used as such for social networks interactions, for the following reasons:

1. Social network's interactions may not have an explicit ending

    EBSG have a predefined start and end, and once the game ends each participants gets a payoff. In a social network, the interactions do not have an explicit ending. Sometimes a person can start an interaction, only to get a response a few days or months after it was originally started, if at all. Also, sometimes people start interactions in social networks and no one replies, which is less common in face-to-face communication.

2. Social network's interactions are less focused

    In an EBSG the steps of the interactions have to be followed. Some interactions have a certain degree of freedom, but in general the interactions follow a series of predefined steps and have a predefined outcome. If the social game is not followed, then it cannot continue and has to be paused or stopped until it can continue. However, in a social network it is common for an interaction to change topic or to create subtopics, and

in several occasions, the original interaction is never resumed but also not explicitly stopped.

3. Actions such as "Like", "Favorite" or "+1" have no equivalent in an EBSG

    In a social network people can explicitly "like" something, a dialog, an image, an interaction, anything. This has no direct equivalent in EBSG.

4. The payoff in an EBSG is achieved at the end of the social game

    Since the interactions in social networks are never finished explicitly (and if they finish, it can take days or weeks), it is more appropriate to give a social benefit on each interaction performed instead of at the end of the complete game.

5 Social Network Interactions

Our model for dynamic social network interactions takes the EBSG approach as used in SimBully, but instead of defining a structure for a complete EBSG, it uses so-called *interactions* that have a smaller granularity. An interaction can either be a comment or post, or a reply to an existing comment or post. The only restriction for all interactions is that an NPC cannot take more than one role in a post or reply. The term *dialog* is used to refer to the content (text, image displayed in an interaction) of an interaction.

Each interaction has a *payoff* that consists of an increment or decrement of the values in the personality model used (e.g., in the 16 basic desires).

We also use the concept of *friendship*. It is up to the user of the model to define its exact meaning. For instance, when using the 16 basic desires as personality model, we can define friendship as follows. An interaction is considered positive when (after the payoff) the total sum of the 16 values is greater than 0, and negative when it is less than 0. If the total payoff of all the interactions between two NPCs is positive (and greater than a predefined threshold), we consider them to be friends. This friendship can be one sided, it is possible that one NPC always has positive interactions with another, while the other responds with negative ones. But it is also possible to define other social network concepts such as *popularity*. For instance, keeping track of all the interactions and their payoffs can provide more information about the NPCs, for example, we can know who has more interactions or more likes, and we can use this information to find out who is the most popular, or who has the biggest amount of negative interactions.

Each interaction contains the following elements. We illustrate the different elements with an interaction from the cyberbullying domain.

1. *Name*
   Each interaction has its own unique name. An example name could be 'Bullying'.
2. *Role*
   Each interaction names the role that the NPC performing this action plays in the interaction. An example role could be 'Bully'.
3. *Target*
   Target indicated to whom the interaction is directed. For example to the "Victim".
4. *Type*
   The type of the interaction is used to identify what kind of dialogs can be used for this interaction. An example type would be 'Bullying'. Different interactions can share the same type, this is especially useful when adding similar interactions where the main difference is how they are triggered. A game designer can add several interactions, which are triggered at different times but they all can use the same dialogs. Therefore, they should use the same type.
5. *Frequency*
   This value is used to determine how often the interaction could be started.
6. *Required interactions*
   Since we are not using entire EBSG structures, we need to define when it is acceptable to use certain interactions. This is done by specifying the list of types of interactions that have to be used in advance in order for this interaction to be usable. For instance, a 'Selfie' and a "Greeting' interaction type could be required interactions for the Bullying interaction.
7. *Requisites*
   Having a list of required interactions is not enough to express all the types of dialogs. For example, suppose we want to have certain interactions that can only occur if a post has been liked more (or less) than a certain number, or we want to limit certain interactions to friends (or enemies). We allow specifying this by means of a list of conditionals that need to be true in order to start the interaction. In these conditionals, values from the personality model used (e.g. any of the 16 basic desires) can be used, as well as the other social network concepts defined (e.g. the friendship level, the number of "Likes"). An example of a requisite is 'Victim.Likes <= 3' where Victim is the target in the interaction and Likes is the number of 'Likes" the NPC got.

8. *Payoff*
   As for EBSG, each interaction has its own pay off, and it is given immediately after the interaction took place. For example, posting a selfie could be given a payoff, even if no one comments on it or likes it.
9. *Like Payoffs*
   One of the problems with EBSG is that there is no equivalent for "Liking". Therefore, in this model, each interaction define the payoff that the person that "likes" it will get, as well as the payoff that the person who started the interaction will get.

With this model we address the issues mentioned in section 4. If there is no response on an interaction this is not a problem since the starter (NPC) already got a payoff, and is not waiting for someone to continue it. If another NPC continues the interaction, then the NPC who started the interaction can decide if it wants to reply or not. Not using the rigid structure of EBSG gives more flexibility, allowing NPCs to start interactions, and continue or create new ones at any time. Furthermore, we have incorporated the typical features of social networks, such as "likes". If an NPC "likes" an interaction, both the NPC that liked and the NPC that started that interaction get a payoff, with the additional benefit that their friendship level may increase (when its definition takes "likes" into account), which is a parameter that can be considered for starting interactions.

Below, we give an example of how the model works. We first define the interactions used. We give the name, role, target, type, and the required interactions; we will omit the rest of the elements because of space limitations. The example is about a cyberbullying situation. Next we show what kind of situations can be realised using these interactions.

Interactions:

Name: Selfie
Role: Starter
Target: Self
Type: Selfie
Required Interactions: None

Name: Greeting
Role: Starter
Target: Target
Type: Greeting
Required Interactions: None

Name: GreetingWithSelfie
Role: Starter
Target: Target
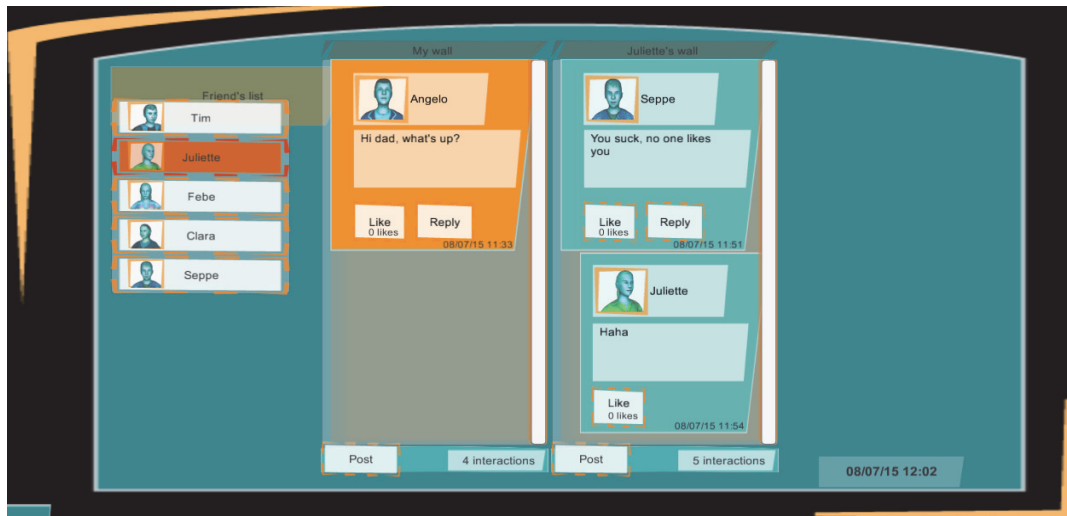Type: Greeting
Required Interactions: Selfie

Figure 4. BullyBook allows the player to see other NPCs interacting

Name: Flirt
Role: Starter
Target: Target
Type: EgoBoost
Required Interactions: Selfie

Name: Bullying
Role: Bully
Target: Victim
Type: Bullying
Required Interactions: Selfie, Greeting

Name: BullyingWithImage
Role: Bully
Target: Victim
Type: BullyingImage
Required Interactions: Selfie
Requisites: Victim.Likes <= 3

Name:StandUp
Role: StandUp
Target: Bully
Type: StandUp
Required Interactions: Bullying, BullyingImage

With those interactions, it is possible to create cyberbullying situations. The following is an example of a situation that can occur in a social network, where an NPC A posts a selfie, some NPCs like it and comment, another NPC bullies A, and another NPC stands up to the bully. Note that *post*, *reply*, *like* are interactions that are predefined.

NPC A posts a selfie (Interaction: Selfie)
  NPC B flirts with A (Interaction: Flirt)
    NPC C likes B post

NPC C greets A (Interaction: GreetingWithSelfie)
NPC D bullies A (Interaction: BullyingWithImage)
  NPC E likes D post
  NPC B stands up to D (Interaction: StandUp)
    NPC A likes B post
    NPC C likes B post
NPC F flirts with A (Interaction: Flirt)

This kind of dynamic interactions cannot be easily replicated with dialog trees. With our model, they can be specified with only 7 different interactions. Moreover, a dialog tree would give similar results every time, in contrast to this model, which would generate different results every time, since the NPCs will select a different interaction based on its values in his personality model, and the values for his social network concepts such as friendships. In (Cebolledo and De Troyer 2015) we describe how such dynamic interactions can be generated.

Note that this approach is not suitable for linear games, or games with a strong narrative, since it is not possible to know the outcome of the interactions in advance, nor when they will be started, but it can be used for dynamics interactions outside of social networks.

This model allows for dynamic interactions, but is not an approach for creating their content (i.e. the dialogs) dynamically. Different (existing) approaches can be used for creating the dialogs. For example, Prom Week is using a list of objects or activities that each NPC likes or dislikes, and several hand crafted dialog templates. The NPC will take his list and the other participant's likes and dislikes into account in order to select the best option (McCoy, J. 2009). Left 4 Dead 2 uses fuzzy pattern matching to determine which dialog to use (Ruskin, E. 2012). These models and similar ones can be combined with our interaction model to create believable dialogs.

6 BullyBook

Our approach for simulating interactions in social networks is applied in BullyBook. BullyBook is a single player game designed to teach teenagers to identifying cyberbullying situations, learn the consequences of cyberbullying and how to cope with it, and stand up for victims. The game simulates a social network, where the player can see his wall and the wall of the other NPCs. The player is free to inspect the other NPCs' interactions, and can decide when to intervene and how (e.g. he or she can support bullying or stand up for a victim). The player can also write on his own wall and like interactions of NPCs. There are different objectives in the game like befriend a certain NPC or to stand up for some victims. A screenshot of the current version is shown in figure 4.

7 Conclusions & Future Work

Social networks are an important element of many people's life. Therefore, being able to simulation them in a believable way in games will become important, in entertainment games but also in games with a pedagogical purpose (i.e. serious games). While there are models for simulating face-to-face social interactions, to the best of our knowledge there are no models for simulating interactions in social networks. The existing models for social interactions cannot be used as such in social networks. This paper presented a model that supports the creation of dynamic believable interactions for social networks. The model is based on Eric Berne's Social Games combined with a personality model. We adapted the Social Games of Berne to achieve more flexibility and to accommodate the characteristics of interactions in social networks. We used our model in BullyBook, a serious game about cyberbullying centred on conversations in a social network.

While we were able to simulate social interaction in BullyBook using this model, there is more work to be done in terms of designing the proper (educational justified) interactions for the game and tweaking the values for the payoff for each interaction. Even small changes in the payoff can make an interaction undesirable or extremely desirable to the point where that is the only interaction being used. Currently, the interactions are specified manually, but an interaction design tool is being planned. Also, we are working on support for debugging and analysing the decisions taken in the game. Due to the dynamic nature of it, it is not trivial to understand the causes of a certain interactions, not for the developer, but neither for the player. However, to achieve effective learning, it is essential that the player understands the consequences of his and others interventions.

References

Adventure Game Studio 2014.
http://www.adventuregamestudio.co.uk/images/intro8_1.jpg
Berne, E. 2010. *Games People Play: The psychology of Human Relationships*. Penguin, USA.

Bethesda 2011. *The Elder Scrolls V: Skyrim*. Bethesda

Cebolledo, E. and De Troyer, O. 2015. *iATTAC: A System for Autonomous Agents and Dynamic Social Interactions–The Architecture.* In Serious Games (pp. 135-146). Springer International Publishing.

Cebolledo, E. and De Troyer, O. 2014. *SimBully: A 'Bullying in Schools' Simulation.* Foundation of Digital Games.

Cebolledo, E. and De Troyer, O. 2014. *Dialogue and social behaviour of agents in games*. The Computer Games Journal 3(1) Candlemas 2014

Evans, R. 2011. *Representing Personality Traits as Conditionals*. AISB 4(1) pp 35-42.

Evans, R. and Short, E. and Nelson, G. *Versu*.
http://versu.com

Facebook, Inc. 2015. *Facebook Reports First Quarter 2015 Results*.
http://investor.fb.com/releasedetail.cfm?ReleaseID=908022

Games, P. 2013. RedShirt.

Goldberg, L. 1990. *An alternative "description of personality": the big-five factor structure*. Journal of Personal and Social Psychology 59(6), pp. 1216-1229.

Michael Mateas and Andrew Stern. *Façade: An esperiment in building a fully-realized interactive drama*. Game Developers Conference, volume 2, 2003.

Maxis. 2009. *The Sims 3*. Electronic Arts.

McCoy, J. 2012. *Prom Week.*

McCoy, J and Mateas, M and Wardrip-Fruin, N. 2009. *Comme il Faut: A system for simulating social games between autonomous characters.* Proceedings of the 8th Digital Art and Culture Conference (DAC), Irvine, CA.

Namaste Entertainment. 2010. *Storybricks.*

NimbleBit 2013. *Tiny Tower*. Mobage.

Paunonen, S and Jackson, D. 2000. *What is beyond the big five? Plenty!*. Journal of Personality 68(5) pp. 821-835.

Reiss, S. 2001. *Who am I? The 16 Basic Desires That Motivate Our Actions and Define Our Personalities*. Berkley Trade, USA.

Ruskin, E. 2012. *AI-driven Dynamic Dialog through Fuzzy Pattern Matching. Empower Your Writers!.*.Game Developers conference 2012, San Francisco, CA, USA.

Strategic Sinergy. 2010. *Steven Reiss 16 Basic Desires Model.*
https://stratsynergy.files.wordpress.com/2010/10/reiss16basicdesires1.jpg

Tupes, E. and Christal, R. 1961. *Recurrent personality factors based on trait ratings*. (Technical Report No. ASD-TR-61-97). Lackland Air Force Base, TX: U.S. Air Force.