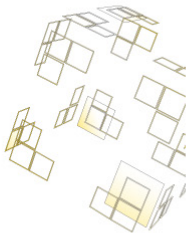
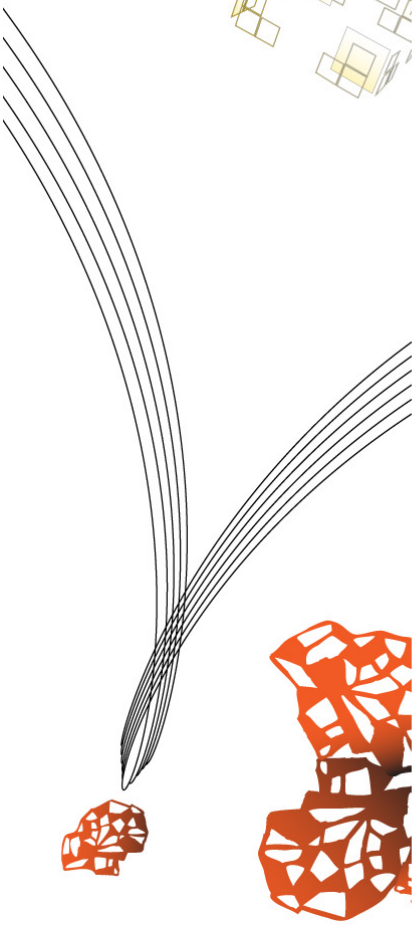
MASTER THESIS

Modelling loitering character agents in conflict situations

Visualizing and evaluating interpersonal conflict strategies



Chris Broekema



HUMAN MEDIA INTERACTION
ELECTRICAL ENGINEERING, MATHEMATICS AND
COMPUTER SCIENCE

EXAMINATION COMMITTEE
Dr. Mariët Theune
Jeroen Linssen, Msc
Prof. Dr. Dirk Heylen

UNIVERSITY OF TWENTE.

September 16, 2014

Contents

1 Introduction

Experience is very important when dealing with difficult situations. This is no different for police officers when it comes to social interaction. There is only little time at the police academy to prepare police officers for social interaction on the streets. Police officers learn a lot of what they know in practice by teaming up with more experienced police officers. Unfortunately this means putting two police officers on the task that can be performed by one. However there are methods to supplement this social interaction training. Social interaction can also be trained using serious games. Serious games are games designed with a primary purpose other than entertainment. These are usually games for educational purposes. The University of Twente is developing a serious game for police officers in training with the cooperation of the Dutch national police and Dutch police academy. In this serious game the police officer needs to learn how to approach groups of juveniles and how to communicate with them to resolve conflicts. The serious game is a learning environment where it is possible to learn from mistakes, since there are no real consequences.

In this thesis we look at interpersonal conflict behaviour and the related conflict strategies. We model the conflict behaviour for character agents, representing loitering juveniles, with the purpose of developing a serious game for police officers in training. In this serious game the police officers can train their social skills and awareness in conflict situations. In this chapter we discuss interactive storytelling in section 1.1. Interactive storytelling can be used as a method to create a simulation where the story emerges from the actions of the characters. In section 1.2 we describe the project and my role in it. We continue with the research questions in section 1.3, followed by the outline of the upcoming chapters in section 1.4.

1.1 Interactive Storytelling

Interactive storytelling [38] is a form of storytelling where the player is capable of creating and influencing the plot with his actions. When there is not just one predetermined plot line, the story can emerge from the actions that are chosen by the players. The problem with this approach is that it is hard to implement this action based narrative and keep the story coherent. It is hard to manage if you also want to achieve global goals with the story. Aylett [2] discusses the theory of emergent narrative. The idea is that the narrative emerges from the interaction between characters. The problem is that this statement is paradoxical since a plot is required to give structure to a story at some point and if this is the case the characters do not have the freedom to create the plot with their interaction. This is called the narrative paradox. An interactive environment can have a strong story, with a predetermined plot, or a strong character autonomy, with characters that have the freedom to choose whatever they want to do. It is possible to combine the two in a balanced form but it is not possible to have a interactive environment that has both due to the narrative paradox. Some interactive storytelling systems, such as Mimesis [51], are plot-driven and follow a plot graph where the characters are guided through the narrative. Other interactive storytelling systems, such as FearNot! [4], are driven by goal-based behaviour of characters. Instead of making a global plot line the characters have sets of goals that they want to accomplish and act upon these goals. Furthermore the characters appraise the actions of the other characters and trigger the appropriate emotions, this allows for intricate believable behaviour.

The Virtual Storyteller [1], which is the predecessor of our current project, uses a multi-agent framework approach for generating stories. The framework consists of several intelligent agents that all do a part of the work. The story-world changes through actions and events. Several Character Agents control their own characters in the story. The story emerges from the interaction between the different character agents. Each character agent receives information about changes in the world and actions that were performed by other characters. This information is used to reason about the next action that the character will perform. In its turn the character agent will select the action that it believes

is the most fitting for the situation.

Story generation can be done around conflict. According to Ware and Young [50] conflict makes a story interesting, it keeps the story engaging. The climax of the story could be the resolution of the main conflict and the sub plots of the story could be organized around conflicts as well. According to Ware and Young generating stories around conflict is very effective. They describe the method 'conflict first' where a story is started with a conflict where the characters build their plans around it. This is called story-centric planning. In our research we will be working with the same assumption. In the simulation the police officer will be called in to handle a disturbance with some loitering juveniles. This means the police officer starts out in a conflict situation and will have to learn how to resolve it.

1.2 Project

This research is part of the COMMIT 'Interaction for Universal Access' (IUALL) project. It was performed for the work package 'Socially Intelligent Agents in Serious Gaming Environments' [11] and is a part of the development of the 'Awareness Game Environment for Natural Training' (AGENT) framework. AGENT is a continuation on the research of the Virtual Storyteller (VST) described by Swartjes [43]. The current focus of the AGENT project is creating a serious game for police officers in training. The serious game, called 'LOITER', is focused on giving the police officers some practical training when it comes to their social skills and social awareness regarding juveniles and their environment. Since the learning goal of the players is to become more socially aware they will need feedback on how other people respond to their behaviour. The players will get clues about the success of their actions from the reactions of the virtual characters. These virtual characters use social models and process the actions of the player to reason about fitting behaviour to respond with [26].

My role in the project is focused on the virtual characters. In my research I looked at modelling the intelligent agents that are responsible for controlling the loitering juveniles. Using existing social theory and interactive storytelling methods I created a computational model that describes the behaviour and attitudes for the character agents. The plan was to let the character agents think like humans and give them human aspects such as personality traits. I looked at a situation where the police officer is sent to resolve a conflict with some juveniles and the conversation that follows. I intended to create believable behaviour for the virtual loitering juveniles to give the police officer in training the opportunity to interact with them and learn from the experience. I created an agent-based model for the virtual loitering juveniles. An agent-based model is a computational model for simulating the actions and interactions of virtual agents [32]. After creating the model I evaluated it with a user experiment, to find out whether the model works and makes the character agents more believable. I started with my research questions that are discussed below.

1.3 Research Questions

In this section I discuss the research questions and the methods that I used to answer them. The main question in this thesis is: *How can we create an agent-based model for conflict behaviour intended for character agents in a serious game for police officers?* To answer this question I wrote a set of sub questions that look at several relevant aspects.

1) *What is the training that police officers get to deal with conflict on the streets?*
To answer this question we arranged an interview with a police officer to learn about their training and experience with conflict on the street.

2) *How do other related systems work with conflict?*
3) *What theories are important to describe interpersonal behaviour?*
I answered questions two and three with information from literature research. I looked at several

different systems that implement conflict or other important aspects related to our research. Looking at theory in the field of computer science related to storytelling and conflict combined with theory from the field of psychology related to personality, interpersonal attitudes and behaviour.

Now we come back to our main research question: *How can we create an agent-based model for conflict behaviour intended for character agents in a serious game for police officers?* Using the gathered theory and methods I learned from the literature research I created my own model. I based the model on theory and concepts from other storytelling systems.

4) *How do we evaluate a character agent with conflict behaviour in a user experiment?*
5) *How does the model perform in a user experiment?*
I looked for a method to evaluate the created model in one or multiple user experiments. I chose visualizations of the interpersonal behaviour to evaluate the behaviour and did an experiment to find fitting postures that match conflict behaviour. I implemented the model and used the selected visualizations for another experiment and presented it to a number of people to evaluate it.

1.4 Outline

In the following chapters we describe our research. We start off with providing some context in chapter 2. We discuss the scenario that we are using and our interview with police officer John. This is followed by related work in chapter 3, where we discuss several systems. Furthermore we describe the relevant theories in chapter 4. We discuss theories about personality, interpersonal stance, conflict, emotion and the belief-desire-intention model. Next is the model that we created in chapter 5. The core of the model consists of the action appraisal, strategy selection and action selection steps. To test our model we needed to create simple conversations between a police officer and a juvenile for use in a user experiment. Since it is hard to illustrate conflict strategies in text we decided to visualize the conflict strategies used by our characters. We discuss our visualization experiment in chapter 6. In this experiment we looked for good posture visualizations that are appropriate for the four conflict management strategies. We evaluated the selected visualizations with a small group of participants. When we found working visualizations for the conflict management strategies we evaluated our strategy selection model using an experiment in comic form, using screenshots from a virtual environment, where the participants evaluated several short conversations between a police officer and a loitering juvenile. The experiment is described in chapter 7. This is followed by a discussion in chapter 8. In the discussion we discuss the limitations of the current work and options for future work. Finally in chapter 9 we recapitulate on what we have done and draw our conclusions.

2 Context

In this chapter we provide some more detail about the context of this project. We describe the scenario that was created for AGENT by other members of our project team in section 2.1 and we provide some context and background information from our interview with police officer John in section 2.2.

2.1 Scenario

For the domain of law enforcement a scenario was developed that provides possibilities for different approaches to communicate with the juveniles as described in [27, 28]. We implemented a part of the setting and characters from this scenario for our research. The scenario is intended for one or two players to play the role of police officers. The story in the scenario starts with a scene where the police officers receive a call about a disturbance caused by a group of juveniles. The police officers needs to find them and diffuse the situation. On the way to the scene the police officers will come in contact with a number of bystanders. They will either help or run according to the approach the police officers take.

When the police officer finds the small group of loitering juveniles he will have to approach them and persuade them to leave. The police officer will have to interact with the juveniles and try to find an acceptable solution for all participants. Depending on the police officer's choices and the juveniles' reactions this might be a polite conversation or lead to an aggressive outburst followed by an arrest. After arresting one of the juveniles or inviting him to talk about the situation at the police station the player will have the opportunity to interrogate the juvenile to learn more about his intentions.

In future work the juveniles should all have their individual personality but could also behave as a group and take a group stance. One of the juveniles could be the leader of the group. The player will have the possibility to display that he is the dominant party or gain their trust. In our research we focused mainly on the conversation between the police officer and the loitering juveniles and looked at methods to model the individual juveniles. The idea is that in a future implementation of the scenario each of the juveniles can react according to his own personality and other relevant factors to accomplish his own goals. For example, some of the juveniles might react aggressively and others might be really helpful.

2.2 Interview Police Officer

We did not want to base the whole project only on theory, therefore we contacted the local police department in Enschede and arranged an interview with a police officer to talk about his work with juveniles. We interviewed youth coordinator John and talked about what it is like to work with juveniles, their approach and what kind of training they had. We summarized the important information of the interview to provide an impression of the situation in Enschede. The questions and the complete transcript of the answers can be found in appendix A. To classify the groups of juveniles the police use the Dutch Beke Shortlist [14]. The Beke Shortlist classifies the groups of juveniles in three levels of groups.

- **'Hinderlijke jeugdgroep'**, troublesome youth groups that are loud and disregard their environment, they incidentally commit minor crimes but still respect authority and can still be addressed about their behavior.
- **'Overlastgevende jeugdgroep'**, nuisance youth groups are more provocative and are considered a nuisance to their environment, they are not shy to use violence and intentionally commit minor crimes.
- **'Criminele jeugdgroep'**, criminal youth groups consist at least partially of juveniles that are criminal, they have come in contact with the law on several occasions and are more likely to

commit crimes with financial motives. They also are not shy to use violence and commit minor crimes.

John told us that in Enschede there are thirteen groups of juveniles known by the police. Two of these groups are considered criminal. The groups of juveniles range from 7 to 20 people and the juveniles are usually between 12 and 17 years old.

When the police is called the complaint is usually about juveniles being a nuisance at known hangouts. The juveniles make too much noise, don't clean up their mess and intimidate other people in their environment. When the police arrives at the scene the juveniles normally deny everything and the police is not allowed to intervene without proof. Because of this the police chooses to observe some groups 'in burger' (in plain clothes) to catch them in the act and they try to involve the parents of the juveniles when possible. The parents are usually blissfully unaware of what their kids were doing on the streets, they react shocked most of the times. Since the problems are usually recurring problems the police also try to assess whether informing youth care is necessary.

John told us that during their training the police officers only spend a few days on how to deal with juveniles and this part of their training is mostly theoretical. Nowadays they do have some extra courses in which police trainers re-enact certain scenarios with the help of actors. This is followed by a discussion about how to handle such situations. These courses help a lot to get a better understanding. After their training the police officers head out on the streets and pair up with more experienced police officers to learn in practice. For John the theory has mostly faded away over the years. John handles most situations based on experience.

Due to budget cuts the police has no time to write extensive reports and evaluate the situations with their team. The police only writes small reports that are shared with youth care and youth workers. When they have come in contact with specific juveniles on multiple occasions they create a file on their history. They do this together with youth care, youth workers, the youth coach of the municipality and the schools that the juveniles are in. When there is time to prepare this information can be used to plan their approach and possibly find out what personality the juveniles have and what subjects are important to discuss.

However, when they are called in on an incident there is no time to look into the information that they gathered. The police officers try to build a positive relation with the juveniles by visiting them regularly and having short friendly conversations with them. When they talk John tries to keep the conversation simple and makes sure that he makes clear arrangements with the group. Since talking with a large group is hard it is usually better to talk to the leader of the group directly. In a lot of cases it is a matter of confronting the juveniles with their behaviour and explaining to them how others think about it. For example, a group of eight juveniles is loitering in front of a shopping mall. Several older people feel threatened by their presence. John said he would approach them by asking: "Can you imagine that those people feel this way?"

However, in more serious cases it is important not to start with accusations when you approach the juveniles. If you do this they will react negatively and this effect will only be increased by the presence of the group. When a police officer talks to a group of juveniles on the street the conversation is always short and takes about 5-15 minutes. However if they talk to the juveniles individually at the police station the conversation can take up to two hours. A conversation on the street usually consists of two simple phases. First the police officer starts with some casual conversation to get acquainted with the juveniles. When this is successful he will follow up with the business phase where he tries to make clear arrangements with the juveniles. If the police officer cannot take control of the conversation he has no choice but to stop and walk away. John ensured us that regular informal contact with the juveniles is very important to maintain a positive relation with them. By visiting the

youth club it is possible to have a small conversation with the juveniles at a location where they feel at ease. It is important to realise that the police is not tasked with finding a solution for the problems or providing assistance with improving their lives. The youth workers perform these tasks. The police will always pass the information along to other agencies that will try to improve the situation.

From our conversation with John we can conclude that practical training with actors is valuable and helps the police officers to experience certain situations in a protected environment. However due to time and budget constraints this will not always be possible. The serious game could be an alternative to supplement the theory with some practice. In our research we focus on the communication with the juveniles and stay away from the criminal aspect. Since conversations with juveniles on the street are usually short and frequent we will try to implement this as multiple short conversations. Furthermore the conversations will require an informal start to get acquainted with the juveniles and their current situation, followed by the discussion about the actual problem. We start with simple conversations between one police officer and one juvenile to focus on the individual relation. The group dynamics, with group behaviour, group leaders and followers and the relations within the group, will be a subject of future research.

3 Related Work

In this section we describe projects that use a similar approach to ours or implement concepts we applied in our research and we will also discuss other projects that model virtual characters with human aspects. We look at 'A Layered Model of Affect' (ALMA), a project that combines emotions mood and personality in section 3.1. Furthermore, we look at the 'FearNot Affective Mind Architecture' (FAtiMA) that is based on the cognitive structure of emotions in section 3.2. Followed by 'GenAttitude' a platform to collect non-verbal behaviour for virtual agents in section 3.3. Furthermore we describe the educational game 'My Dream Theatre' that implements conflict theory in 3.4. Finally we describe a few other systems that have a role in the field of serious games and modelling behaviour of virtual agents in section 3.5.

3.1 ALMA

ALMA (A Layered Model of Affect) is a model to provide virtual humans with a personality profile and real-time emotions and moods [16]. ALMA combines the three major affective characteristics emotions, moods and personality. ALMA uses two phases: in the first phase the appraisal rules and personality profiles are specified and in the second phase they are used to compute real time moods and emotions. The appraisal rules define how a character appraises events and actions that are related to him. For example, 'the sun is shining' is a good event.

Emotions are used as short-term affect and are usually bound to a specific event or action. Moods are used for medium-term affect and are generally not related with specific events and actions. The personality is used for long-term affect. The personality in ALMA is specified using the Big Five Model of personality. The Big Five Model is discussed in section 4.1. Mood in ALMA has three dimensions (Pleasure, Arousal and Dominance). The emotions used in ALMA are based on the OCC model of emotions. More about the OCC model can be found in section 4.4.

ALMA is implemented into the VirtualHuman system, a system that aims at the development of concepts and techniques for human-like conversational characters. ALMA works together with a dialog generation component. The three kinds of generated affect are used to improve a virtual character's cognitive processes and are used for creating verbal and non verbal expressions. Figure 1 provides an example of a character with two different expressions and the dialog that is generated. On the left side in a hostile mood and on the right side in a relaxed mood.

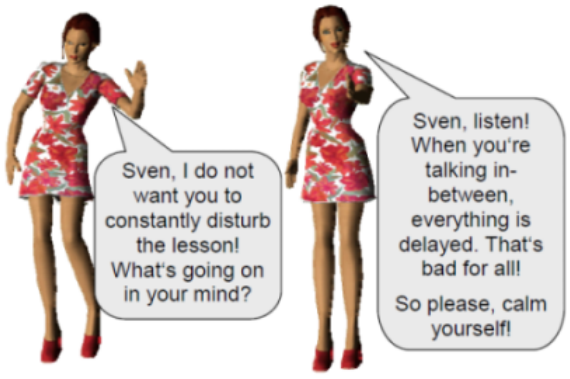


Figure 1: Example of the VirtualHuman system.

In more recent work empirical data is used to derive the emotional intensity in a variety of situations [24]. By conducting user studies they collected enough empirical data to analyse In the experiments

the users rated certain emotions on a scale from 1 to 10 for some described scenarios where they had to imagine how they would feel in that situation. This data was then combined with the OCC model to parametrize the emotions for ALMA.

For my research I used the concepts of personality and mood from ALMA as an inspiration to model personality and related factors as a part of the strategy selection as described in section 5.

3.2 FAtiMA

The FAtiMA (Fearnot Affective Mind Architecture) agent architecture was developed to create affective emergent narrative [29]. It is a framework for emergent narrative that has intelligent agents that can react to their environment, use emotions and have goal-based behaviour. The framework was intended for the creation of virtual dramas and the specific topic that was selected for this project is anti-bullying education.

The FearNot! [4] demonstrator was developed to show children what happens in bullying situations, where they could take responsibility without feeling victimized themselves. In this demonstrator a character agent that plays the role of the bullying victim attempts to establish an empathic relationship with the child and asks the child for advice as an invisible friend. The agent changes its behaviour using the advice of the child while trying to stay believable. Figure 2 provides an example of the FearNot! demonstrator where the character has just been bullied.

Figure 2: Example of the FearNot! demonstrator.

FAtiMA provides the agents with two distinctive levels of appraisal and coping mechanisms. The reactive level provides fast appraisal and reactions to events while the deliberative level takes longer and is capable of more complex behaviour. The appraisal mechanism uses a set of emotional rules to handle appraisal at the reactive level. Each rule consists of a trigger event and emotional variables affected by the event (such as desirability, praiseworthiness). The deliberative layer is responsible for appraising events using character goals and generates emotions such as hope and fear. It uses two types of goals. The first type called active-pursuit goals are the ones that the character is actively trying to achieve and the second type are the interest goals that represent the goals that the character passively pursues, such as avoiding to get hurt.

In a later implementation of FAtiMA Double Appraisal (DA) was implemented [3, 29]. The idea of DA is that the emotional impact of an action can be used to make the narrative interesting. A character would not only take an action based on his emotions and goals but also take into account the emotional impact of a specific action on itself. Seen from the view of the character: “How would

I feel if someone did this action to me?" This is implemented as an extra loop in the appraisal process where the emotional impact of each possible action is assessed. This process does not affect the emotional state of the agent since it runs in parallel with it. An extension of the DA action selection mechanism is Double Appraisal with Modelling (DAM). This uses the same principles as DA but it not only considers the impact of the action on itself but tries to find the action that has the highest emotional impact on all the characters within the scenario. The question that the character agent will ask: "Could I affect the most people with this action and how would they feel if I did this action?" To accomplish this it uses the emotional reaction sets of all the agents present in the scenario. The actions and speech actions from the generated stories were displayed in text format. These were presented to a test audience whose dramatic perceptions and judgement of dramatic intensity were documented. When the extensions were compared with the single appraisal-based architecture the produced simulations scored higher. When DAM and DA were compared for perceived dramatic values [29] DAM consistently scored higher. This suggests that DAM has a stronger dramatic potential.

Hussaini [21] discusses upcoming work for FAtiMA that adds group dynamics for the character agents. According to theory, people in a group interact on the basis of three interpersonal needs: inclusion, control and affection. Groups have multiple cycles of inclusion, control and affection. The group starts off with multiple individuals that try to find common ground after which the leaders of the group are defined and finally the members of the group want to maintain a satisfactory relation with the group. In the affection phase emotions play a large role. To implement this FAtiMA will be combined with the PSI theory of emotions by Dörner [5]. In his model emotions emerge from cognitive processes and emotional parameters. It is a different approach from FAtiMA since the model depends on the drives of the characters and the thresholds they have for particular needs. In the new version of FAtiMA the motives (Energy, Integrity, Affiliation, Competence and Certainty) from PSI will be included.

In my research I used the concepts of the deliberative layer from FAtiMA and implemented them in my model as described in section 5.

3.3 GenAttitude

GenAttitude is a platform to collect non-verbal behaviour for virtual agents. Humans use non-verbal behaviour to convey interpersonal attitudes. Brian Ravenet and his colleagues have worked on a model [40] and the necessary tools [33] to compute the non-verbal behaviour of a virtual agent based on a corpus of non-verbal behaviour created by users. The method that is used to represent the interpersonal attitude is the interpersonal circumplex. The interpersonal circumplex is discussed in section 4.1. This representation uses two dimensions: agency, which is a scale from dominant to submissive, and communion, which is a scale from hostile to friendly. Looking at research in the social sciences they identified the body parts that are used to convey the interpersonal attitudes. GenAttitude presents the user with a set of parameters to change the visualization of an avatar to match one of the four social attitudes from the interpersonal circumplex for a particular communicative act for a male or female agent. This can be for example, deny something with a submissive attitude for a male agent. The parameters that were available to the users are:

1. The type of facial expression: smile, frown or neutral
2. Gesture: none, head movement only, arm movement or both
3. Amplitude of gesture: small, medium or large
4. Power of gesture: small, medium or strong
5. Head position: straight, up, down or tilt on the side
6. Gaze: gaze at or gaze away

When the users were done playing with the parameters they could submit the image. Ravenet accumulated the results to get an overview of what the parameters are for dominant, submissive, friendly and hostile attitudes. This study using GenAttitude showed that there is a correlation between the facial expressions and gestures and the type of communicative act. However, the gender of the agent and user do not seem to have an impact on the selected parameters. In Figure 3 you see a screenshot of the GenAttitude application where the parameters can be selected.

Figure 3: A screenshot of GenAttitude.

The results from this experiment are used in my visualization experiment in section 6.

3.4 My Dream Theatre

My Dream Theatre is an educational game that is aimed at teaching children, aged 9 to 11, conflict resolution skills. The setting of the game is a theatre club where the user has the role of the director. The user selects his own cast for each performance. The cast members are non-player characters that have their own characteristics such as a preference for roles, and personality. When the user is assigning roles conflict situations will emerge due to conflicting goals that the cast members have. The user is required to intervene in the conflict to assure a good performance in the end [9]. In Figure 4 you see a screenshot of My Dream Theatre where two characters have a discussion about a role.

Figure 4: A screenshot of My Dream Theatre.

According to Campos conflict varies around five dimensions: participants, causes, initiating action, responses and outcomes [8]. To resolve conflicts, participants can take several approaches: accommodation, avoidance, competition, collaboration and compromise. These approaches are all comprised of a level of assertiveness and a level of cooperativeness [45]. In a prototype two groups of behaviours were generated to escalate a conflict. The first group called Attacking is used by agents with a high assertiveness and low cooperativeness. An attack behaviour sequence in a escalating conflict could be: lesser insult, criticize negatively, harsh insult, and threat. The second group is called Evading. The agents that use evasive behaviour start with low assertiveness and low cooperativeness. An Evading behaviour sequence could be: ignore the situation, sacrifice his own goals to avoid further involvement and, finally, leave the scene.

The conflict model that is used for the above implementation uses three phases: conflict recognition, conflict diagnosis and conflict behaviour selection [7]. In the recognition phase the character agent's perceptions are checked for actions or events that could affect him or his goals, furthermore it classifies the importance of the conflict. In the conflict diagnosis phase the agent will determine how the event could affect him and whether it is positively or negatively. Finally in the behaviour selection phase the agent will select a strategy based on its assertiveness and cooperativeness and selects an appropriate action based on the intensity of its emotions.

For my model I used conflict resolution strategies and their position on the interpersonal circumplex similar to the Attacking and Evading behaviour as described by Campos. We extended them with the Cooperative and Accommodative behaviour that have a high cooperativeness.

3.5 Other Systems

There is a lot more work on serious games and modelling social interaction and human-like behaviour for virtual characters. Some other systems that try to implement human characteristics such as turn-taking or serious game aspects are described below.

The Mission Rehearsal Exercise (MRE) system [44] was created at the University of Southern California with the goal to expose junior army officers to dilemmas that might occur during their missions. MRE used a scenario in Bosnia where the officer is exposed to things like a injured civilian and a riot. The successor of MRE is called Stability and Support Operations (SASO) which continues to function as a simulation and training tool for the US Army [46]. However in our research we are not looking

at global dilemmas yet. This work can be used in the future when more extensive negotiations are required.

Another system is the Virtual Rapport Agent [20]. The system is designed to establish rapport with a human participant by providing nonverbal feedback using backchannelling. Backchannelling is a kind of feedback that signals that the listener is still interested such as head nods or statements like 'um-huh'. Turn-taking, the negotiation process that regulates who the speaker and who the listener is at a given moment, is also an important aspect of rapport. Rapport is something we could look at in future research. This is useful for establishing the relation between the police officer and the juvenile.

Finally we have the deLearyous system [48]. deLearyous is a serious game that is used to train communication skills following the interpersonal circumplex. The user can write natural language which will be processed and used in the conversation with the virtual agent in a company setting where the user has the role of a manager. DeLearyous is a serious game that uses the interpersonal circumplex just as My Dream Theatre. However the company setting is different from our police domain and it has a strong focus on natural language which is not the focus of our research. The natural language technology is promising but still has a long way to go.

4 Theory

In this section we describe the important theories that we used to base our work on. The concepts we grouped in this section are derived from our related work. We describe the theory of personality as a mental construct to organize information about social partners. We look at the 'Big Five', one of the robust models to characterize personality in section 4.1, followed by theories about interpersonal stance. We describe the theory about the stance that a conversational partner takes during the conversation as a combination of agency and communion in section 4.2. Furthermore we discuss the theory of conflict, with the conflict strategies competition, collaboration (which we call cooperating), avoidance and accommodation in section 4.3. We also describe the cognitive theory of emotions that is used for appraisal. We discuss a simplification of the OCC model that is used for appraisal in section 4.4. Finally we describe the BDI model in section 4.5. The BDI model translates human practical reasoning into a model for intelligent character agents.

4.1 Personality

A personality is the collection of individual differences, dispositions and temperaments of a person that are observed to have some consistency across situations and time [13]. A person's personality is not something that is perceived the same by everybody. Someone's personality is based on expectations of others and the consistencies others see. Personality is a mental construct that people use to organize information about all their social partners. Personality is also a perspective to describe a person's personal traits. According to Dryer [13] character agents are perceived to have personality traits as well. This has been observed in tests where users had interaction with social agents. People seem to react similarly to character agents as they do to real conversation partners.

A designer tries to shape the perceived personality of the characters that he creates. Instead of creating a character that has unintended personality traits it is possible to design a character's personality. According to Dryer [13], characters always need some flaws to make them seem realistic and sometimes people prefer characters that have a characteristic that complements their personality. For example, somebody with a dominant personality would prefer a character with a submissive personality. Dryer presents a set of guidelines for creating personalities for virtual characters. For example, it is better to create strongly expressed personalities than subtle ones and consistency is very important. In our research we assigned personality traits to our character agents.

The variety of human personalities is infinite. Several researchers have been working on mapping personality into usable factors. Although there are thousands of facets to personality, according to Digman [12] only five factors are required to describe the major dimensions. McCrae and John [30] describe these five factors and discuss the implementations of the model for individual assessment. The Five-Factor Model (FFM) of personality describes a personality using five basic dimensions: Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness. This model is also known as the Big Five. We use this model for personality since it is a robust model that has been validated by many researchers [12].

Neuroticism represents the tendency to exhibit poor emotional adjustment and experience negative affects, such as anxiety, insecurity, and hostility.

Extraversion represents the tendency to be sociable, assertive, active, and to experience positive affects, such as energy and zeal.

Openness to experience is the disposition to be imaginative, nonconforming, unconventional, and autonomous.

Agreeableness is the tendency to be trusting, compliant, caring, and gentle.

Conscientiousness is comprised of two related facets: achievement and dependability.

We use an implementation of the Big Five to represent personality in our model. We use the two factors Extraversion and Agreeableness for the strategy selection, see section 5.3. We also keep in mind the guidelines that Dryer presented and use them for the setup of our experiment.

In research about the effect personality has on leadership [22] the Big Five are linked with leadership. Extraversion, Openness and Conscientiousness are positively related to leadership, Neuroticism is negatively related with leadership, Extraversion is strongly related to leader emergence. Agreeableness and leadership have an ambiguous relation. Agreeableness could lead to good cooperation but it is also considered as a weakness and lack of leadership. The relation between leadership and personality could be used for implementing group behaviour and selecting a fitting group leader in future research.

4.2 Interpersonal Stance

Stance defines the attitude that somebody adopts with respect to somebody or something, it can also be described as a mental posture. The interpersonal circumplex is a two-dimensional space that represents interpersonal stance organized as a circle with no beginning or end [19]. This model is also referred to as Leary's Rose [25] and interpersonal stance. The interpersonal circumplex uses a scale from hostile to friendly, which is also called agency, and a scale from dominant to submissive, which is also called communion, see Figure 5. The two dimensions of the interpersonal circumplex are comparable to the dimensions extraversion and agreeableness in the Big Five. Agency is used to describe aspects like dominance, power, status and control. Communion suggests love, affiliation, union and friendliness.

Figure 5: Interpersonal Circumplex from [42].

According to Orford [34], somebody is more likely to select a stance that complements the behaviour of his conversational partner. On the Assertiveness scale opposites attract and on the Cooperativeness scale equality attracts. See Figure 6. However other factors such as status, responsibility and self-confidence also have an impact on the amount of dominance that is displayed. We use the complementing behaviour as a factor for strategy selection in our model.

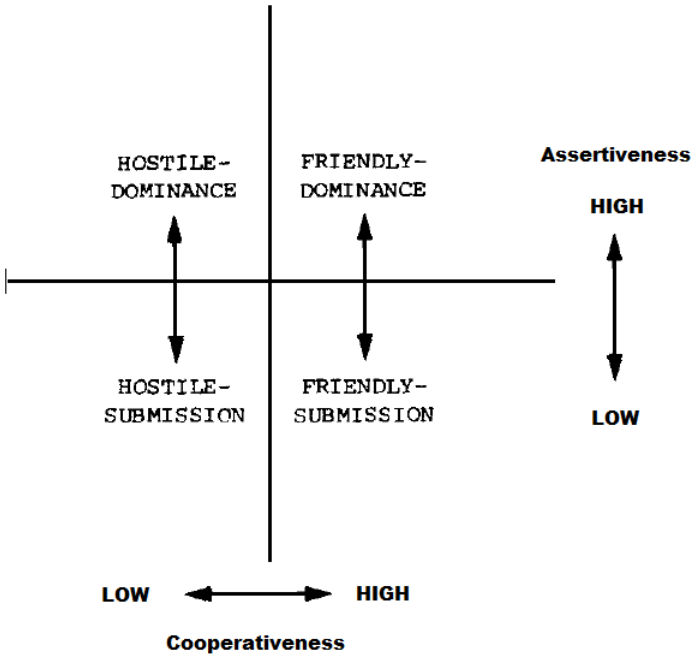


Figure 6: Complementing behaviour from [34]

4.3 Conflict

Thomas [45] defines conflict as 'the process which begins when one party perceives that another has frustrated, or is about to frustrate, some concern of his'. According to Thomas there are five approaches to manage conflicts. They are competing, collaborating, avoiding, accommodating and compromising.

Competing is pursuing your own concerns at the expense of others. Which could mean using whatever is necessary to win.

Collaborating is attempting to work together to find a solution that satisfies everybody's concerns.

Avoiding is the opposite of collaborating. This means not dealing with the conflict, which can be in the form of delaying or withdrawing.

Accommodating is neglecting your own concern to satisfy the concerns of others. This could be generosity or yielding to another's view.

Compromising is finding a mutually acceptable solution that partially satisfies all parties. This could be seeking a quick middle-ground solution.

These conflict strategies are classified by the underlying dimensions assertiveness and cooperativeness which are very similar to agency and communion. See Figure 7 for the conflict strategies. Agency is a scale from dominance to submissiveness which we also call assertiveness and communion is a scale from hostility to friendliness which we also call cooperativeness.

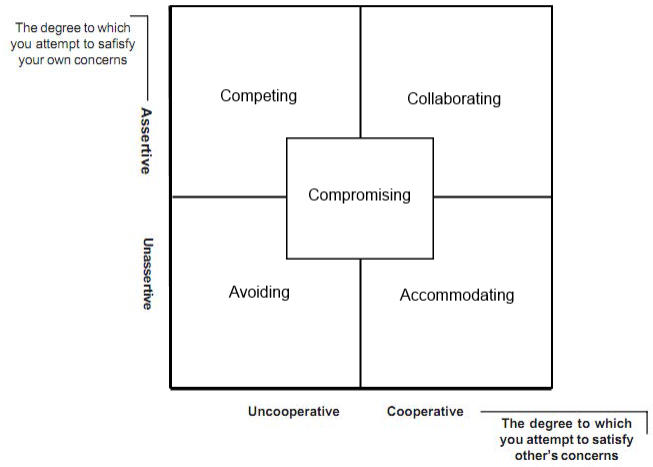


Figure 7: Conflict management strategies from [10]

Ware and Young [50] presented a model that defines conflict using seven dimensions. These dimensions are: participants, subject, duration, directness, intensity, balance and resolution.

Participants are for example two characters. However, a character could also have a conflict with the environment when he is unable to perform a certain action. A character can even be in conflict with himself when he has two conflicting plans.

Subject is the fact in the world that is contested. This can be a contested resource but can also be a pair of complementary goals that are conflicting.

Duration is the upper and lower bound of the time it would take to resolve the conflict. It starts when conflicting plans are formed and it ends once one plan is finished or abandoned.

Directness is a measure of how closely the participants are related. For example, friends or family relations.

Intensity is a measure of how much is risked by being involved in the conflict.

Balance measures the likelihood that the participants fail or succeed in the conflict.

Resolution measures the outcome of the conflict. This is a personal value which tells us the result for the agent compared to the others in the conflict. However there are three types of discrete resolutions. Collaboration which is a win/win situation, contest which is a win/lose and disaster which is a lose/lose.

Cheong et al. [10] describe a model for conflict resolution that uses the theory of Thomas. The model uses five phases, which they tested in a simple resource management game. The five phases are described below.

Conflict creation Conflict can arise due to conflicting goals and certain types of actions that are taken. For example if a goal of character A is related to a goal of character B it could mean that only A or B can happen and not both at the same time. Even if A and B are positively related there still could be a conflict due to the actions taken by the characters. There are two types of

actions that influence a goal. Effective actions improve the chance to achieve a goal and bungling actions decrease the chance to achieve a goal. If goals A and B are positively linked a character could (unintentionally) perform a bungling action which would jeopardize the goal of the other character as well resulting in a conflict situation.

Conflict detection The resource management game is required to know when conflict occurs to be able to guide the player towards constructive conflict resolution. Affect is an important component of conflict. Conflict escalation could be detected by recognizing negative emotions from the player. If these emotions can be detected the escalation of a conflict can be estimated. This can be done by tracking the gestures and facial expressions of the player but could also be done by categorizing the actions that a player has already performed.

Player modelling and conflict strategy prediction The system develops a model for each player to infer the conflict strategy that the player uses. This model is created using the three elements assertiveness, cooperativeness, and relationship. The conflict strategy that is assigned to the player model is derived from the assertiveness and cooperativeness as used in Figure 7. This is combined with the relationship that the player has with the other characters. If a character A used an accommodation strategy while playing with B, who bullied him in the past, his relation with B would be described as negative. The next time A could choose to withdraw due to their negative relationship and choose an avoiding strategy. Furthermore the system could use conflict strategy prediction to predict the conflict management style of the player using player models from previous sessions if they are available.

Conflict management Conflict management is the step where a strategy is selected. The possible strategies are described in the theory about Thomas above. This process could be influenced by circumstances in which certain strategies have advantages over others. For example if the goal is significant enough or the relation with the other person is important it would pay off to collaborate or compromise. However if the character is powerless an accommodating or avoiding strategy would be more appropriate.

Conflict resolution The conflict strategies are used at an individual level in behaviour, however we also have conflict resolutions that are used at a situational level. The conflict resolutions are: intervention, stand-off, submission, withdrawal and compromise. Conflicts can be resolved in different ways than the characters intended. If for example player A wants to collaborate but agrees to a sub-optimal proposal by B who adopts a competitive strategy the conflict is resolved by A with submission. Conflicts will also have different outcomes based on the resolution. These outcomes are for example satisfaction, material benefits and costs and relationship changes between the parties.

Our model is inspired by the dimensions from Ware and Young and phases from Cheong et al. Especially the player modelling and the conflict management phase were useful. We also use the conflict management strategies, proposed by Thomas, in our model in section 5.3.

4.4 Emotion

Interactive storytelling architectures such as FAtiMA base their emotional models on the cognitive theory of emotions by Ortony, Clore and Collins [36]. This cognitive theory of emotions is also known as the OCC Model of emotions. Ortony [35] describes the important factors for creating a believable emotional agent. An important part of making a believable emotional agent is consistency. The internal responses (emotions) and external responses (behaviour) need to match with the situation and be appropriate for the individual. A simplification of the OCC model created by Ortony [35] divides emotional reactions for a character agent into two sets: positive and negative reactions. Each set consists of a generic reaction and five specializations.

Positive reactions: Joy, Happiness

1. Hope
2. Relief
3. Pride, Gratification
4. Gratitude, Admiration
5. Love, Like

Negative reactions: Distress, Sadness

1. Fear
2. Disappointment
3. Remorse, Self-anger, Shame
4. Anger, Reproach
5. Hate, Dislike

The expression of emotions was not the focus of this research. However we use the theory of emotion, described above, in our model for our action appraisal step. A character agent will rate the action of another character positively or negatively based on the emotion that is associated with the action for the character agent. See section 5.2 for more information about the action appraisal step.

Since in our context juveniles are usually loitering in small groups it is also interesting to look at the effects that emotions have in groups. There have been many studies on mood and emotions in small groups [23]. A lot of the research is based on moods and emotions on a individual level. There are multiple processes where individual affective experiences are shared with other group members. Some of these processes are happening without conscious awareness and others are deliberate attempts to influence others. Group emotions can vary from sharing discrete emotions or a low-level shared mood. We did not implement these emotions yet. Emotions and shared emotions are an important step for future research.

4.5 Belief-Desire-Intention model

The belief-desire-intention (BDI) model is a well known model for practical reasoning agents. The model was established in the mid-1980s and it is still commonly used in agent technology. The model combines human practical reasoning with computer science [17, 39].

Beliefs represent knowledge about the world. The beliefs are the perceptions and knowledge that an agent has with its local view. In computational terms they only represent a state of the world. They can be implemented as variables, expressions or a database.

Desires represent motivations for the agent. Desires are usually seen as goals. In computational terms they represent a desired end state.

Intentions represent the commitment of the agent. The agent is required to commit to plans and sub-goals it adopts but must be able to reconsider when appropriate. Computationally the intentions are a set of executing threads that can be interrupted upon receiving feedback that the world has changed.

We used the concepts of BDI in our model. We used the beliefs and desires in the appraisal phase in section 5.2 and we used the intentions in the Active Pursuit Strategy in section 5.1.3.

4.6 Integration into agent-based model

In the following chapter we describe how we combined several methods and theories that we found in the related work and theory and used to create our own agent-based model. We created our model in the context of the conflict situation from our scenario. The model was intended for simulating the action selection and interaction of the character agents representing the loitering juveniles. For simplicity we looked at a conversation between two characters that respond to each other.

Since we use a turn-taking system the character agent will start its turn with appraising the action performed by its conversational partner. At this moment the character's beliefs, desires and emotions are important. The character agent will update its mood during the appraisal step to reflect the effect the action had on him. The BDI concepts and the cognitive theory of emotions are important in this step.

In the next step the character agent will reason about its strategy to respond with. This strategy will be based on its personality traits, the stance used by its conversational partner and the character's intentions. The theory of personality, interpersonal stance and conflict are important here. These aspects together will result in a conflict strategy that the character agent will use to select a fitting action in the next step.

When selecting an action the character agent will have to take several factors into account. These factors are: the context of the conversation, the selected conflict strategy and its current mood.

In the next chapter we describe our agent-based model with focus on the strategy selection step.

5 Model for Appraisal, Strategy and Action

In this section we present our model for appraisal, strategy and action. The model is intended for the action selection process of virtual characters and uses the beliefs, desires and intentions approach combined with personality and strategy. We start with discussing the variables that we assign to a character agent in section 5.1. The model consists of three phases which are highlighted in Figure 8: the action appraisal phase, the strategy selection phase and the action selection phase. In this research we focused on the strategy selection phase which we also evaluate in an experiment in section 7. In a conversation between two virtual characters both characters will continue to go through these steps on their turn. In the action appraisal phase, described in section 5.2, the character appraises the action that its conversational partner performed. The character decides whether to respond and how it feels about the action, which could have an effect on his mood. If the character responds it continues with the strategy selection phase, described in section 5.3. It selects a conflict strategy based on the Personality, the Complementing Strategy and the Active Pursuit Strategy (PeCoAPS). Finally in the action selection phase it combines the result from the strategy selection phase and its current mood to select a fitting action to perform, which we describe in section 5.4. We use a conversation between a police officer that is controlled by a human and a juvenile that is a virtual character in our example in section 5.5.

The complete process that leads to selecting an appropriate action is visualized in Figure 8. The process starts with receiving a message that another character has performed an action in step 1. If the character is controlled by a human player a user interface will be displayed to select an action. When the character is controlled by a character agent it will start with the appraisal phase in step 2. If the character decides to respond it will calculate a strategy using the strategy selection phase in step 3. Using the resulting strategy from the strategy selection phase and the updated mood from the appraisal phase the character agent will calculate the best suited action in step 4. This is followed by performing the selected action which is translated as sending an action message in step 5.

5.1 Character Agent

In our model a character has a personality based on the Five Factor model (FFM) from [30], an active pursuit strategy (APS), a simple mood and a set of desires and emotions that are linked to specific actions. The personality and APS are used as variables in the action selection process and the desires and emotions are used in the action appraisal where the character decides how he feels about the actions of other characters.

5.1.1 Personality

For simplicity a character's personality has a Low or High value for each of the aspects from the FFM (Extraversion, Agreeableness, Neuroticism, Openness and Conscientiousness). Currently I only use the values for Extraversion and Agreeableness since they are the factors that are linked with Assertiveness and Cooperativeness [18, 19].

5.1.2 Mood

In our model a character has a mood that is simply a single value that ranges between very unhappy and very happy. The concept mood is based on the mood used in ALMA as described in section 3.1. Where emotions are usually a direct reaction to an action, the mood is a more long term concept. The mood of a character is affected by the actions of other characters. The mood of the character will be used here as an internal value and could be visualized later to provide the player with direct feedback on the success of their actions. Mood and emotions are not the focus of this study, we do not express them but only use them as internal values.

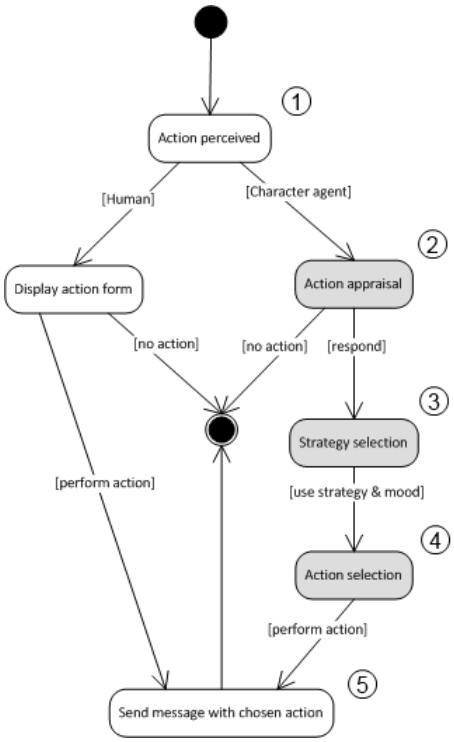


Figure 8: Action selection steps

5.1.3 Active Pursuit Strategy

The active pursuit strategy (APS) is the approach that the character has selected that is based on its active pursuit goal. The active pursuit goal is the main goal that the character is currently trying to achieve just like in FAtiMA described in section 3.2. For example, when the goal is to assist the other character, the character agent would choose to be humble and comply with the other character's behaviour, this would be an accommodating APS. From a BDI perspective this goal is also known as his intention. Since the active pursuit goal is the commitment of the character agent and the APS is the intended method to achieve the goal. For interpersonal goals the active pursuit strategy is the attitude that the character uses towards another character to achieve the goal. For other goals, that are not related to other characters, it depends on the situation, since the active pursuit strategy is only noticeable in interaction with other characters. A character does not require an active pursuit strategy for a goal such as 'going to the toilet' when there are no other characters around him. However it is still possible to have a strategy associated with such goals when the situation would require communication with other characters to achieve this goal. The APS of a character can also be translated back to a value for assertiveness and a value for cooperativeness, since a strategy is based on assertiveness and cooperativeness. The APS could change during the conversation. For example if an agent accomplishes its active pursuit goal it could adopt a new goal that requires a different approach. I added the APS to the action selection process since a character has a choice in his actions. I believe the conflict strategy that is used for action selection should not only be based on personality and complementing the conversational partner, but take into account the goals the character is pursuing as well. Each interpersonal goal that a character agent has requires a corresponding APS. The APS will be assigned to each goal on creation. For simplicity the APS has predefined values in our experiment where we evaluate the strategy selection model in section 7, since we did not look into planning and assigning goals into our study. This part of the model still requires more validation in future work.

5.2 Action Appraisal

In the action appraisal phase the character appraises the action that its conversational partner performed. The action appraisal steps are shown in Figure 9. We start with the character agent receiving an action message at step 1. This message is processed and the character changes its mood according to its desires and related emotions at step 2. Finally the character decides whether to respond or not in step 3. For each action performed in a conversation the character agent could see the action as

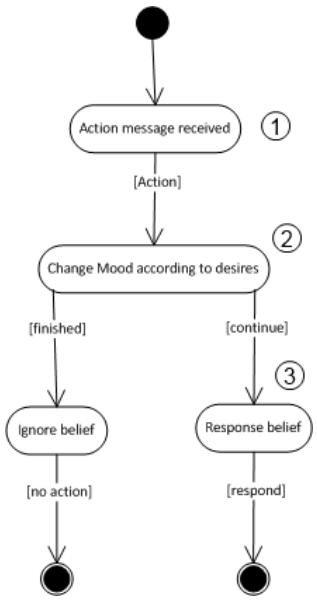


Figure 9: Action appraisal steps

positive or negative for his desires or goals. This will be appraised based on the emotion that the character links with the action using the emotion groups from section 4.4. For example, when the other character draws a firearm. This action causes distress in the form of fear for the character agent. Since fear is a negative emotion this will have a negative impact on the mood. Not every action has an effect on a character's mood and some actions can be neutral. Not every action asks for a response. When a character is convinced that it should respond to an action of another character we say it has a 'response belief'. However when a character is convinced that it should ignore or say nothing or even leave we call it a 'ignore belief'. With most actions the character will have the intention to respond based on the response belief. If the conversational partner asks a question the character will most likely adopt a response belief. However when the conversational partner leaves the scene the conversation is over and the character will adopt an ignore belief. Furthermore when a character has a very negative mood, after appraising the action of the conversational partner, it will decide it is finished with the conversation and could adopt an ignore belief as well. I have not researched the options for linking emotions and desires to the appropriate actions. In the evaluation of the strategy selection model in section 7 I use predetermined actions and do not explicitly visit the appraisal step during the experiment.

5.3 Strategy Selection

In the strategy selection phase the character agent selects a fitting strategy to respond with. The agents will select the strategy for their next action based on the values of their Personality, the Complementing Strategy of the strategy that the conversational partner used and the Active Pursuit Strategy that the character has chosen (PeCoAPS). These three factors represent the impact of the

personality on behaviour, the impact of social expectations on behaviour and the impact of intentions on behaviour.

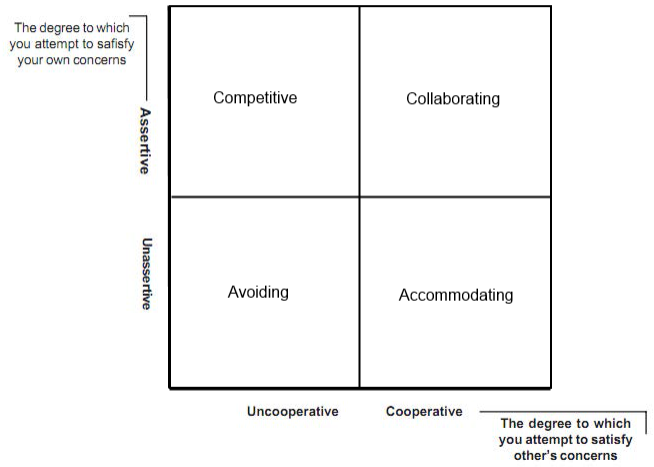


Figure 10: Conflict management strategies from [10] without the compromise strategy

We look at the conflict strategies by taking the values of the underlying dimensions assertiveness and cooperativeness. In our model we only look at the extremes with the values of assertiveness and cooperativeness being only low or high, which means we do not use the compromising strategy. The values from the personality are based on the extraversion and agreeableness of the character and are expressed as assertiveness and cooperativeness. A high extraversion translates to a high assertiveness and low agreeableness translates to a low cooperativeness. This matches with a competitive strategy as we can see in Figure 10. The active pursuit strategy is the strategy that best fits the intentions of the character, it is the strategy that corresponds with the goal that the character is currently trying to pursue. We assume that the character agent is able to classify the stance that is used by his conversational partner. The complementing strategy is the opposing strategy as described by Orford [34] in the form of complementing behaviour, see section 4.2.

Normally these three factors would probably not have an equal weight on the decision for selecting a new conflict strategy and the weight given to each factor could differ for each character. For simplicity they are in this model used as equally important. The weight of the three factors requires validation and could change after testing in the future. The three factors provide the character agent with three pairs of assertiveness and cooperativeness values. The assertiveness and cooperativeness values are added together as forces that control the strategy on the interpersonal circumplex. The strongest direction will be the strategy selected. For example, if the assertiveness is two times low and once high the character agent will use low assertiveness and if the cooperativeness is three times high it will use high cooperativeness. This would mean that the character would select an accommodating strategy.

5.4 Action Selection

During the conflict between a police officer and a juvenile each of the conversational partners can perform actions that can be verbal but also non-verbal. For each combination of a mood value and a

strategy there should be a matching action. However when selecting the action the character will also have to take the context of the current conversation into account. For example if the conversational partner asks a question the character will try to respond with an answer for the question.

For the evaluation of the strategy selection model in section 7 I created some simple actions myself and based some of the competitive and avoidant actions on the attacking and avoiding actions from Campos [8].

5.5 Example

For this example we use the police scenario with two characters. The police officer named Adrie meets with a juvenile named Barry in the park. Each character has a set of starting values. Barry has a personality with a low extraversion factor and a high agreeableness factor. Barry has the intention to help the police officer to get him to leave without causing any trouble for him. The matching APS for this goal is collaborating. He currently has a neutral mood and just wants to be left alone in the park and meet with his friends. The conflict strategies based on assertiveness and cooperativeness are shown in Figure 10.

Adrie starts with performing a competitive verbal action towards Barry: "Hey you!" This is step 1 in Figure 8. This is followed by step 2, where Barry appraises the action performed by Adrie. Barry is a little bit afraid of Adrie. Adrie's action negatively affects the mood of Barry. However Barry is not immediately in such a negative mood that he stops responding; he is convinced that he has to respond, since Adrie is talking to him.

Barry continues with step 3 and starts with selecting an appropriate strategy to respond with based on his personality, active pursuit strategy and the complementing strategy of the action performed by Adrie. The current values for Barry can be found in Table 1.

Aspect	**Assertiveness**	**Cooperativeness**	**Strategy**
Personality	low	high	accommodating
Active pursuit strategy	high	high	collaborating
+ Complementing strategy	low	low	avoiding
Result	low	high	accommodating

Table 1: Values for Barry that are used to select his strategy.

Based on the strongest forces, low assertiveness and high cooperativeness, Barry will select a accommodating strategy. Combining this strategy and his slightly negative mood we follow up with step 4 and find an appropriate accommodating action for Barry to respond with. He could for example respond with "What can I help you with, officer?", "What did we do wrong?!" or "I did not do anything wrong!" Since his mood is still mostly neutral he could respond with a restrained "What can I help you with, officer?"

5.6 Evaluating the model

To test our agent-based model we wanted to apply it in several small conversations between a virtual police officer and a virtual juvenile. With our limited time we were not able to implement our agent-based model in character agents. This is why we chose to create the conversations in a comic form. The focus of our model was the strategy selection step which we wanted to evaluate in our user

experiment. Since it was hard to express strategy in verbal behaviour we looked towards non-verbal behaviour to express the selected conflict strategy. Inspired by Ravenet's research [40] we wanted to use the posture of the character agent to show the used conflict strategy to the participant of the experiment.

Unfortunately there were no visualizations of the posture of character agents representing the conflict strategies available yet. This is why we decided to create them ourselves using a preliminary experiment described in section 6. We want to get the right visualizations that portrait the intended amount of assertiveness and cooperativeness. We selected twelve postures and showed them to some participants for evaluation. Based on the evaluation we selected the best one for each strategy. We implemented the selected postures for our character agents in a virtual environment and used them in several conversations in comic form to evaluate our model in section 7.

6 Visualization Experiment

When simulating a conversation each character agent in its turn selects an action that is fitting for the situation. Although a conversation can be implemented in text with verbal actions and descriptions of how the characters feel and react, this is hard to implement. Using verbal conversations is not an easy method to display differences in strategy since it is hard to generate a coherent text that will be recognized as the applied strategy by all users. As an alternative we decided to use non-verbal behaviour to display the changes in strategies instead while keeping the verbal conversation the same. We expressed the strategy in the posture of the virtual character. To test the actual use of conflict strategies we had to visualize each conflict strategy to be able to create an implementation of the model that could be evaluated in a user experiment.

To adequately visualize the strategies we performed a preliminary experiment. In this section the preliminary experiment is described to create appropriate postures for each strategy. We start in section 6.1 with the theory and the method to create the visualizations. This is followed by the hypotheses in section 6.2, the method we used to perform the experiment in section 6.3 and the participants in section 6.4. Furthermore we discuss the results of the preliminary experiment in section 6.5, followed by a short discussion in section 6.6.

6.1 Strategies and non-verbal behaviour

We started by selecting multiple postures of virtual characters based on the non-verbal parameters to visualize conflict strategies [40], as described in section 3.3. Ravenet collected data about virtual agent's non-verbal behaviour using an application called GenAttitude. The application presents the user with a task, a visualization of the current settings and a set of controls to change the parameters. They collected data for each of the extremes of the interpersonal circumplex. The interpersonal circumplex is displayed in Figure 11.

Figure 11: Interpersonal Circumplex from [42].

The results from Ravenet's research show that:
Dominant is characterized by a negative facial expression, head and arm gestures, the absence of gaze avoidance and an upward position of the head.
Submissive is described as a neutral expression, only head movement, downward position of the head and gazing at or away from the conversational partner.

Hostile is similar to dominant, it is characterized by a negative facial expression, head and arm gestures, no gaze avoidance, however the head position is down.
Friendly is represented by a positive facial expression, a slight preference to arm gestures only, no gaze avoidance and a tilt of the head.

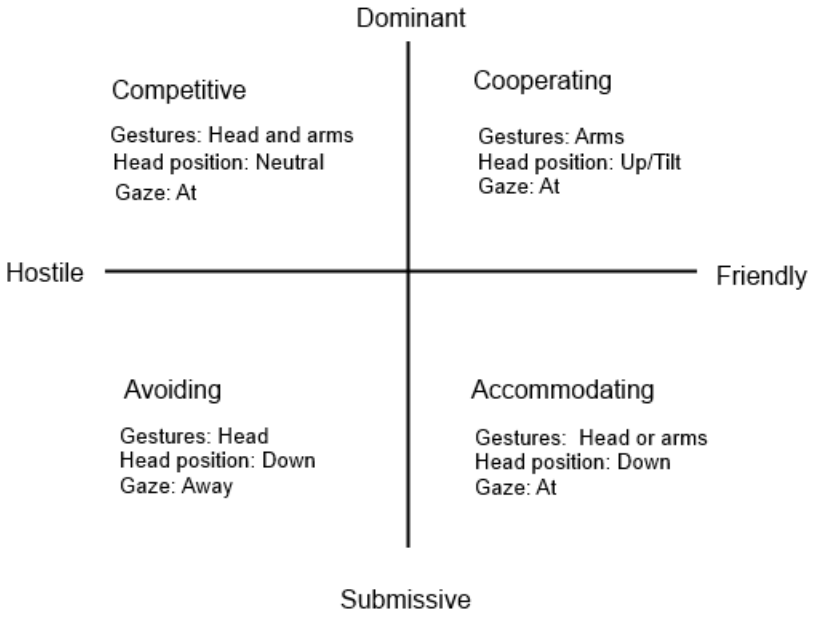


Figure 12: Combining the parameters from Ravenet into conflict strategies

Combining the extremes of the interpersonal circumplex we get the conflict strategies since they are defined as a combination of assertiveness and cooperativeness. For our experiment we left out the power and amplitude variable from Ravenet since we did not animate the character agent but only used screen-shots. we will also not be looking at the facial expression since this is a complete field of research on its own [37]. The variables that we used are displayed in Figure 12. Since Ravenet measured the extremes of the interpersonal circumplex and we used the sectors in the interpersonal circumplex that correspond to the conflict strategies we had to combine some of the variables for the conflict strategies. For example, Competitive is a combination of Hostile and Dominant behaviour. For competitive behaviour we chose for a neutral head position as the average of dominant and hostile. For the accommodating gestures we chose for head or arm movement since both the submissive and friendly gestures parameter in the research of Ravenet had no strong preference.

Finding a virtual agent that is easy to animate or model is hard. There are many advanced tools available but none of them are easy and quick to use for a simple experiment. Since we have no prior knowledge on modelling characters we used a alternative method. Instead of animating a virtual agent we looked at existing animations on Mixamo [31]. From these animations we made a screen-shot at the right moment where the posture was best visible. We selected twelve images, three images for each of the four conflict strategies. All the images that we selected contain at least two out of three variables from Figure 12. Due to the fact that we used existing animations it was hard to find images that matched perfectly with variables from Ravenet. The resulting images are shown below.

Figure 13: Cooperating images

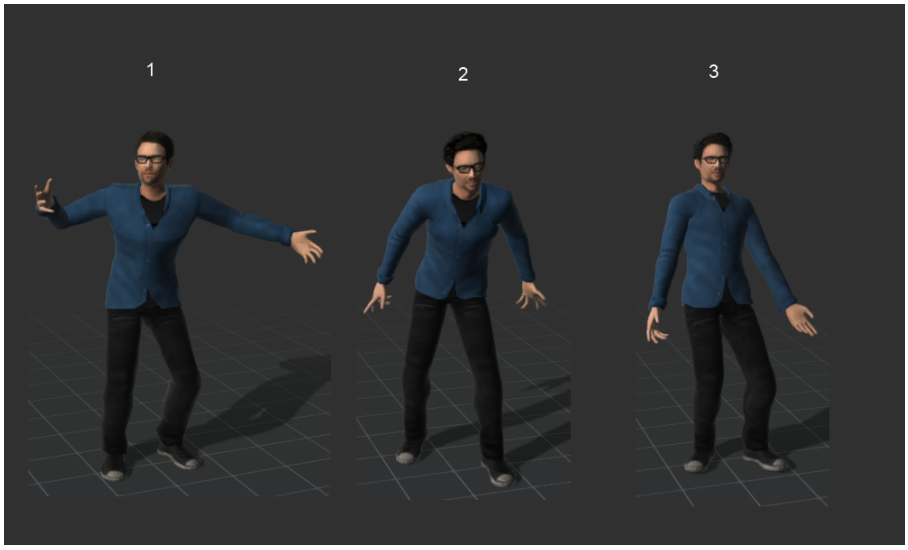


Figure 14: Competitive images

Figure 15: Avoiding images

Figure 16: Accomodating images

6.2 Hypotheses

In the preliminary experiment we tested the previously described screen-shots of conflict strategies using images of a virtual character that had a posture that displayed the conflict strategy. For this experiment we had two hypotheses.

1. Participants can (intuitively) rate a posture's fittingness to a conflict strategy.
2. The postures are rated as having a similar level of assertiveness and cooperativeness as the conflict strategies that they were intended to convey.

6.3 Method

The experiment was implemented as a web-form that could be filled in online in about fifteen minutes. Each of the twelve images were rated with 3 questions for each image. For the first question the images were rated on a five-level Likert scale from submissive (1) to dominant (5), this is the assertiveness. The second question was implemented as a five-level Likert scale from hostile (1) to friendly (5), this is the cooperativeness factor. These factors together should already give a good impression if the image fits with the strategy. Finally the third question also uses a five-level Likert scale and is: 'Do you think the posture fits with cooperating behaviour?' in the case of the cooperating images, with competitive, avoiding and accommodating for the other images. This question asks directly if the participants think the image is fitting for the strategy. There was one open question for each strategy that allowed for the participants to write down what they associated with the conflict strategies, stated as: 'Describe in key words or a small sentence what cooperating behaviour or posture looks like to you.' and finally we asked a few demographics questions. More details about the setup of this experiment can be found in appendix B.

6.4 Participants

In this experiment seven people participated. Their age ranged from 22 to 42 and two of them were female. Most of the participants selected that they had at least a reasonable amount of experience with virtual characters.

6.5 Results

In this section we present the results for each of the four conflict strategies. We calculated the mean and standard deviation for each question for each individual image.

Cooperating Image	1		2		3	
	M	SD	M	SD	M	SD
submissive - dominant	3.286	0.7	2.857	1.355	4.429	0.728
hostile - friendly	4	0.926	2.857	0.639	2.143	1.125
Fits with the strategy	4	0.756	3	1.195	2.286	1.03

Table 2: Results of the three cooperating images

Cooperating
Comparing the results of question one and two with question three might lead to results that tell us that for example the cooperating images do not really have to be very dominant to look like the character is cooperating. For cooperating image 2 this is the case. The posture is seen as fitting and friendly but it is neutral when it comes to assertiveness. Image 3 is rated as dominant and is seen as a little bit hostile which probably makes it look competitive and not fitting for cooperative behaviour. With an average rating of 4 on the question if the image fits with the strategy image 1 is the best rated for the cooperating strategy. See Figure 17 for the assertiveness and cooperativeness. The shaded area in the image is cooperating. In the open question the participants all agreed on the fact that cooperating behaviour requires a open posture with friendly gestures. Some participants also mentioned a gaze at the conversational partner.

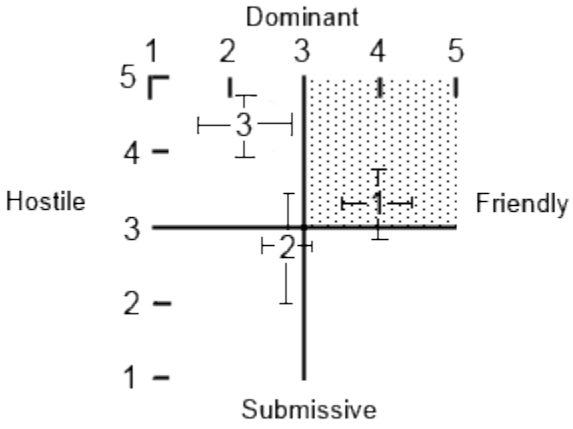


Figure 17: Cooperating results on the assertiveness and cooperativeness scale with SD.

Competitive Image	1		2		3	
	M	SD	M	SD	M	SD
submissive - dominant	4.857	0.35	4.571	0.495	3.143	1.457
hostile - friendly	1.571	0.495	1.286	0.452	2.571	0.904
Fits with the strategy	4.714	0.452	4.714	0.452	3.143	1.355

Table 3: Results of the three competitive images

Competitive
The results of competitive are clear. Image 1 and 2 are both seen as very dominant and hostile and fitting with a competitive strategy. With an assertiveness rating and fitting with the strategy rating of more than 4.5 they are both convincing. Image 3 is rated around 3 on all three questions, this image does not seem to be competitive. See Figure 18 for the assertiveness and cooperativeness. The shaded area in the image is competitive. For the open question the participants agreed on an active, provocative pose with aggressive movement. The posture should occupy a lot of space. Some participants also mentioned the eye contact and direct gaze.

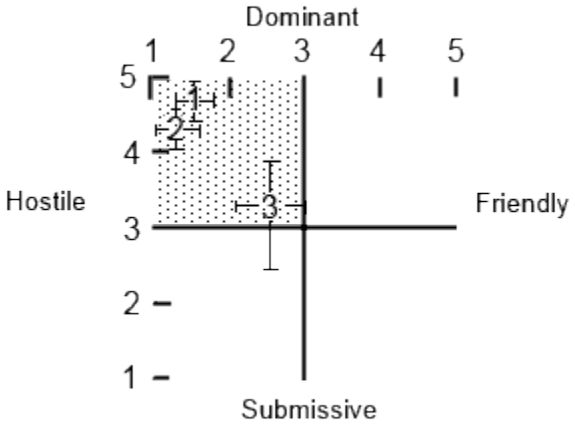


Figure 18: Competitive results on the assertiveness and cooperativeness scale with SD.

Avoiding Image	1		2		3	
	M	SD	M	SD	M	SD
submissive - dominant	3.857	0.99	1	0	4	0.535
hostile - friendly	2.714	0.881	3.714	1.161	2.143	0.99
Fits with the strategy	3.429	1.294	3.714	1.161	4	1.309

Table 4: Results of the three avoiding images

Avoiding
The results of the ratings of the images for the avoiding postures are less convincing. The assertiveness and cooperativeness values are located in the wrong regions. Although all three images are rated above the mean on the fitting scale with an average above 3, image 1 and 3 are rated as dominant. Image 2 seems fitting as well but is instead rated as friendly. The comments from some participants indicated that all three images had a feature that they expected in avoiding behaviour but individually they were not very fitting. They would have expected the arm movement from image 1 combined with the gazing down or away from image 2 or 3. See Figure 19 for the assertiveness and cooperativeness. The shaded area in the image is avoiding. In the open question the participants stated that avoiding behaviour should be with a closed posture and avoiding eye contact, displaying a lack of interest in the situation.

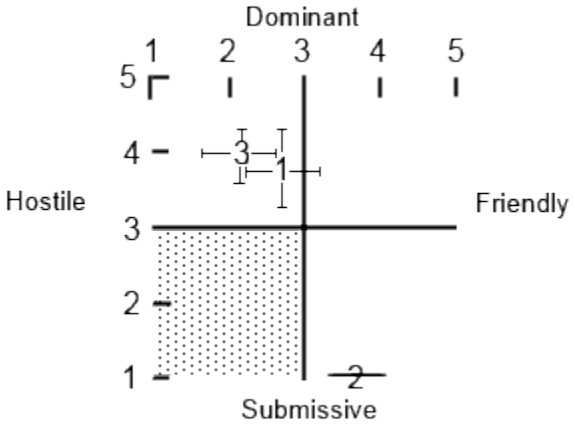


Figure 19: Avoiding results on the assertiveness and cooperativeness scale with SD.

Accommodating Image	1		2		3	
	M	SD	M	SD	M	SD
submissive - dominant	1.571	0.728	2.571	1.178	3.714	0.7
hostile - friendly	3.571	1.05	3.857	0.833	3	0.756
Fits with the strategy	3	0.926	3.429	1.05	2.571	0.728

Table 5: Results of the three accommodating images

Accommodating
The results for accommodating posture were not as clear as competitive but still were in the right direction. Image 2 seems to be the best choice based on the relatively low level of assertiveness and relatively high level of cooperativeness. Image 1 is rated as fitting and has a low assertiveness that is even lower than that of image 2. However it is also a bit less cooperative. It looks like image 3 is more likely to be displaying cooperating behaviour due to the high rating on the assertiveness scale. See Figure 20 for the assertiveness and cooperativeness. The shaded area in the image is accommodating. The participants stated in the open question that an accommodating posture should occupy less space and be a submissive, mostly closed posture. Some explained it as agreeing with the other and only one mentioned the eye contact variable as looking away or down.

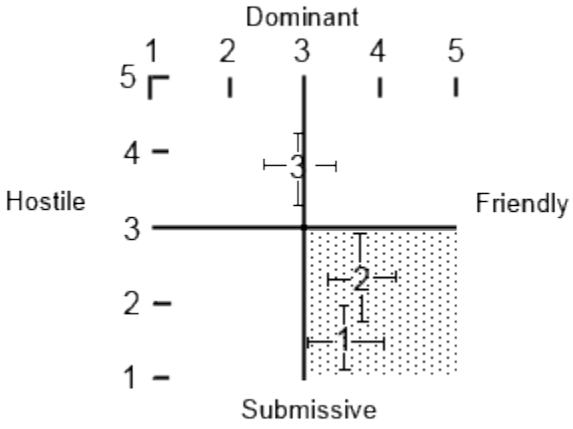


Figure 20: Accommodating results on the assertiveness and cooperativeness scale with SD.

6.6 Discussion

This experiment provided an overview of how participants think about conflict strategies and what they think is the best fitting visualization. The results are used to select the visualisations for the evaluation of the model.

Comparing the results with the theory of Ravenet it seems image 1 for cooperative behaviour is the best fitting image. It matches with all three of the features from Ravenet that we focused on and was rated as fitting with the rating of 4. For competitive all three images matched the variables of Ravenet and were rated as being competitive. Both image 1 and 2 are rated as fitting and either one of them could be used for the follow-up experiment. The accommodating results were not rated as high but image 1 and 2 clearly end up in the accommodating region of the interpersonal circumplex. Although they matched the variables of Ravenet it seems accommodating behaviour is harder to recognize and visualize. For the next experiment both image 1 and 2 could be used, but with the slightly higher fitting value for image 2 we would prefer this to represent accommodating behaviour. Unfortunately for avoiding behaviour the rating results were inconclusive. However using the feedback from the participants it is clear that all of the images used had features of avoiding behaviour. Combining the arm position from image 1, face down and submissive posture from image 2 and the look away from image 3 we should be able to create a new image that visualizes avoiding behaviour.

Furthermore the experiment gave good insight into what participants look for in certain strategies. Very dominant behaviour is more likely to be seen as competitive than cooperative and avoiding behaviour is hard to visualize. However the opinion of the test subjects could have been influenced by the words we choose to represent the strategies. Since one word is not a complete description and people can have a different idea about certain words this could have influenced the results. It is possible that most subjects were not matching avoiding with hostile, submissive behaviour but had other associations instead. In the follow-up experiment we intended to avoid this by giving the participants a group of adjectives to match with the strategy or avoid naming the strategies all together and let the participants look at a conversation that implements them. Based on the results we choose the following images for the following experiment: Competitive 2, Cooperative 1, Accommodating 2 and a new image for Avoiding. The selected images are displayed in Figure 21.

Figure 21: The selected visualizations and the corresponding strategy.

7 Evaluating the Strategy Selection Model

With the postures representing the conflict strategies from the previous experiment we started with our next experiment. In this experiment we wanted to verify the results of the previous experiment on more participants and use the postures to test our model. The core of our model consists of the strategy selection which was the main focus of this experiment. We try to test the strategy selection using a number of short conversations. Each conversation in the experiment is represented by a short comic of six images.

We created a scenario in which a police officer meets a group of juveniles in the park to talk about their behaviour. The police officer named Adrie has multiple small conversations with the leader of the juveniles called Barry. We implemented the postures selected in the previous experiment for both Barry and Adrie. The experiment consisted of three parts. First the participants matched the postures with fitting adjectives from a given list. Secondly they looked at the small conversations in comic form. Twice in every conversation the participant was presented with a choice between two images. This is illustrated in Figure 22. The posture of the juvenile was the only difference between the two images. The first image, option A, represented a strategy that was based on the complementing strategy which was the baseline. We choose the complementing strategy instead of random behaviour to keep the juvenile more believable. The second image, option B, represented the strategy from my model that was based on a combination of Personality, the Complementing Strategy and Active Pursuit Strategy (PeCoAPS). Finally the participants rated the believability of the characters and had the opportunity to comment on their behaviour.

We start with discussing the virtual environment in section 7.1. This is followed by the hypotheses in section 7.2, the method we used to perform the experiment in section 7.3, the conversations we created in section 7.4 and the participants in section 7.5. Furthermore we discuss the results in section 7.6, followed by a short discussion in section 7.7.

7.1 Virtual environment

The 3D virtual environment that was used for the scenario and the characters was created in Unity [47]. The scenario consisted of a small park in the middle of a city. The park was surrounded by several large apartment buildings and city blocks. The scenario was created in Unity with the available free models and textures from the asset store. The characters that were used came from Mixamo [31]. Some textures were added to give the police officer his uniform. The postures were manually rigged in Blender [15] based on the results of the previous experiment. Rigging is the process where you use a skeleton of your virtual character to make an animation. You manually move the bones to move the character. Unfortunately we had trouble with the facial expression which we did not edit and was not completely neutral. Using the 3D virtual environment with the created characters several screenshots were made from two different angles to simulate the conversation. See Figure 23 and Figure 24 for the result.

7.2 Hypotheses

For each part of the experiment we made a hypothesis that describes the outcome of the experiment that we expected. For the first part we expect that the participants can intuitively match the postures with adjectives that describe the stance corresponding to the conflict strategies. This would mean that the postures were a good representation of the conflict strategies. In the second part of the experiment we tested PeCoAPS. We expected the participants to prefer PeCoAPS over the baseline. Finally the police officer had a predetermined posture and the juvenile used a posture based on theory with input from the participant. Therefore we expect the juvenile to be more believable.

1. Participants can match the postures with adjectives that describe the conflict strategies.

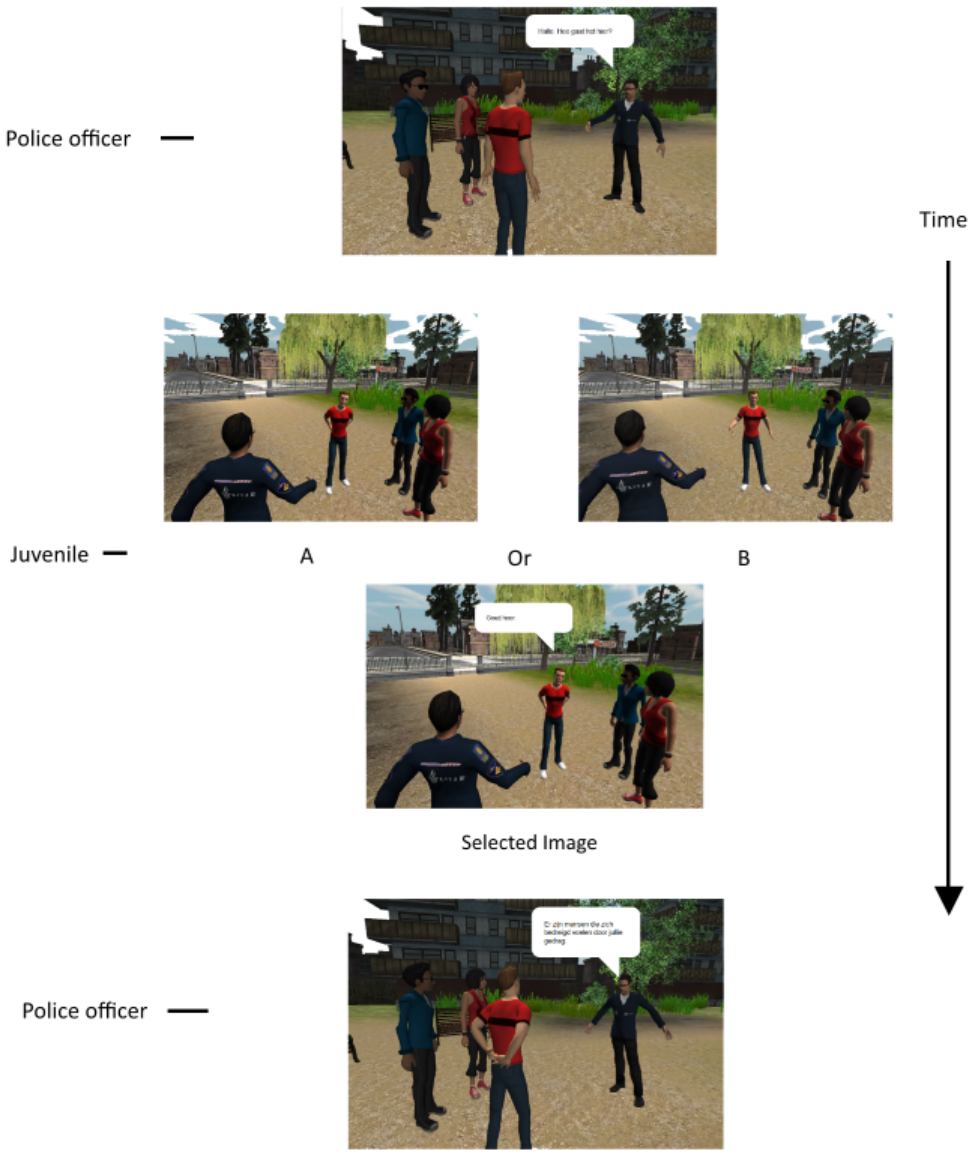


Figure 22: Evaluation of the experiment in comic form.

2. Participants prefer the use of PeCoAPS over the complementing strategy.
3. Participants rate the juvenile as more believable than the police officer.

7.3 Method

In this experiment we simulated the use of PeCoAPS and tested it against the Complementing Strategy. Unlike the previous experiment the whole experiment was performed in Dutch to make sure there was no language barrier. The experiment was divided in three parts. The first part was used to verify that the images for the conflict strategies matched with the expectations of the participants. The second part consisted of eight conversations that presented two choice moments per conversation

Figure 23: A screenshot of the park with the viewpoint on the police officer.

where the participant could choose between the result of the complementing strategy and PeCoAPS. Finally the experiment had some questions about the believability of the characters and a demographics section with the possibility to leave a comments. More details about the setup of this experiment can found in appendix C.

First the participants had to select three adjectives from a list of 25 adjectives for each of the four postures representing a conflict strategy. The postures are described in the results of the previous experiment. Since we had no clear result for the avoiding strategy in the previous experiment we created one based on the comments from the participants. The posture for the avoiding strategy can be found in Figure 25. The 25 adjectives were selected from a larger list of adjectives of a Dutch version of the interpersonal circumplex [41]. This was used to verify the association that the participant had with the images. The adjectives used can be found in Appendix C.1.

We used a series of eight small conversations between the police officer and one of the juveniles. The conversations were displayed in a random order to each participant. When we wrote the scenarios we determined all the verbal actions and postures for the police officer. Furthermore we also determined the verbal actions for the juvenile and the choices that the participants could make. We tried to minimize the impact of the verbal text that the character used by creating all possible types of verbal expressions (dominant, submissive, hostile and friendly, neutral) and chose them to seem reasonable for both the choices that were provided. The meaning of the verbal action would be based on the strategy that was used to express it. For example, saying 'hey!' would have a different meaning when it is combined with a hostile posture than it would have with a friendly posture. The conversations were displayed in a random order. Before each conversation the personality and active pursuit strategy of the juvenile were described in a few small sentences. See Appendix C.2 for the descriptions of the personality and active pursuit strategy that were used.

Two times in each conversation the participant was presented with a posture for the juvenile from the complementing strategy (model A) and one from PeCoAPS (Model B). The participant was not

Figure 24: A screenshot of the park with the viewpoint on the juvenile.

informed of the different models and what posture represented the outcome of which model. The displayed order of the images of model A and model B was randomized as well. Each time the participant had to choose how the juvenile would perform his reaction by selecting one of the two images. The question that was asked here was: 'What is the best fitting posture for Barry to respond with?' After selecting the posture the system added the verbal action to the selected posture and continued. See Figure 26 for an example. The participant did not know yet what the juvenile was going to say when they chose a posture. The participant was not allowed to select the strategy for all of the juvenile's actions since some times the result from the complementing strategy and PeCoAPS resulted in the same posture. This was minimized to once every conversation while creating the conversations. For this experiment we left the mood component out of the conversations to limit the dimensions of the experiment and focus on the strategy selection.

7.4 Conversations

The focus lies on the juvenile for the evaluation. We provided the juvenile with values for his personality and a different Active Pursuit Strategy (APS) for each conversation. Each personality and APS was used twice during the conversations. Since PeCoAPS currently gives equal weight to the personality, APS and complementing strategy it is possible for two of the three variables to cancel each other out resulting in always choosing the third. When the personality and APS are opposites on both the agency and communion scale the complementing strategy will be the tie breaker on both dimensions and will always be selected. Furthermore if the personality and APS are the same, the complementing strategy would have no impact and the strategy selected would always be the same. To ensure that the results from our model were different from the complementing strategy we selected the combinations of personality and APS that are adjacent on the interpersonal circumplex. The actual values for each conversation can be found in Table 6. For the police officer we used each possible starting strategy twice. To make sure that the postures for the police officer were not selected randomly, we selected the postures for the police officer by rotating over the interpersonal circumplex. The values that were used for the police officer in each conversation can be found in Table 7. The complete conversations

Figure 25: A screenshot of the new posture for Avoiding.

with the verbal actions in Dutch can be found below in Table 8-15. The strategies selected for the police officer and the options that the participants had are also listed. The different models are listed as option A (the complementing strategy) and option B (PeCoAPS).

Conversation	**Personality**	**APS**
1	Accommodating	Cooperating
2	Accommodating	Avoiding
3	Avoiding	Accommodating
4	Avoiding	Competitive
5	Competitive	Avoiding
6	Competitive	Cooperating
7	Cooperating	Competitive
8	Cooperating	Accommodating

Table 6: Combinations of personality and Active Pursuit Strategy of the juvenile for the different conversations.

Figure 26: A screenshot of the experiment where the participant had to choose the posture.

Conversation	**Starting Strategy**	**Rotation**
1	Competitive	Counter-clockwise
2	Avoiding	Counter-clockwise
3	Cooperating	Clockwise
4	Accommodating	Counter-clockwise
5	Competitive	Clockwise
6	Accommodating	Counter-clockwise
7	Cooperating	Counter-clockwise
8	Avoiding	Clockwise

Table 7: Starting strategy for the police officer and rotation over the strategies in the interpersonal circumplex.

Who	**Strategy**	**Verbal action**	**How selected**
Police Officer	Competitive	"Hey daar!"	Pre-set
Juvenile	A → Avoiding, B → Accommodating	"Waar kunnen we u mee helpen?"	Choice
Police Officer	Avoiding	"Hoe gaat het hier?"	Pre-set
Juvenile	A → Competitive, B → Accommodating	"Best."	Choice
Police Officer	Accommodating	"Ga je dat nog in de prullenbak gooien?"	Pre-set
Juvenile	Cooperating	"Ja natuurlijk. Sorry."	A and B

Table 8: Conversation 1

Who	Strategy	Verbal action	How selected
Police Officer	Avoiding	"uhm..."	Pre-set
Juvenile	A → Competitive, B → Avoiding	"Wat is het probleem?"	Choice
Police Officer	Accommodating	"Ik ben gestuurd omdat er klachten waren over geluidsoverlast."	Pre-set
Juvenile	A → Cooperating, B → Accommodating	"Wat moeten we dan doen?"	Choice
Police Officer	Cooperating	"Dit is geen hangplek, helaas moeten jullie ergens anders heen gaan."	Pre-set
Juvenile	Accommodating	"We gaan wel bij het clubhuis kijken of daar wat te doen is."	A and B

Table 9: Conversation 2

Who	Strategy	Verbal action	How selected
Police Officer	Cooperating	"Hey. Is er geen school vandaag?"	Pre-set
Juvenile	Accommodating	"Nee wij hebben vrij vandaag."	A and B
Police Officer	Accommodating	"Kunnen jullie wat rustiger zijn?"	Pre-set
Juvenile	A → Cooperating, B → Accommodating	"We zullen ons best doen."	Choice
Police Officer	Avoiding	"Ik kom later wel terug."	Pre-set
Juvenile	A → Competitive, B → Avoiding	"Dat is helemaal niet nodig. Tot ziens."	Choice

Table 10: Conversation 3

Who	Strategy	Verbal action	How selected
Police Officer	Accommodating	"Hallo."	Pre-set
Juvenile	A → Cooperating, B → Competitive	"Wat is er aan de hand?"	Choice
Police Officer	Cooperating	"Iemand heeft zijn blikje niet in de prullenbak gegooid."	Pre-set
Juvenile	A → Accommodating, B → Avoiding	"Sorry. Ik was het niet."	Choice
Police Officer	Competitive	"Gooi het gewoon weg, het is duidelijk dat jij het was!"	Pre-set
Juvenile	Avoiding	"Voor deze keer dan..."	A and B

Table 11: Conversation 4

Who	Strategy	Verbal action	How selected
Police Officer	Competitive	"Hey jongens!"	Pre-set
Juvenile	Avoiding	"Wat is er?"	A and B
Police Officer	Cooperating	"Er is een klacht binnengekomen over het geluid van scooters."	Pre-set
Juvenile	A → Accommodating, B → Avoiding	"Daar weet ik niets van."	Choice
Police Officer	Accommodating	"Reed jij net niet zo hard voorbij op die scooter?"	Pre-set
Juvenile	A → Cooperating, B → Competitive	"Dat was ik niet."	Choice

Table 12: Conversation 5

Who	Strategy	Verbal action	How selected
Police Officer	Accommodating	"Hallo."	Pre-set
Juvenile	Cooperating	"Goedemiddag."	A and B
Police Officer	Cooperating	"Ik ben op zoek naar de persoon die de muur daar beklad heeft."	Pre-set
Juvenile	A → Accommodating, B → Cooperating	"Daar heeft toch niemand last van?"	Choice
Police Officer	Competitive	"Het is schandalig dat mensen zo andermans eigendom vervuilen!"	Pre-set
Juvenile	A → Avoiding, B → Competitive	"Sorry hoor. Wij wisten niet dat het een probleem was."	Choice

Table 13: Conversation 6

Who	Strategy	Verbal action	How selected
Police Officer	Cooperating	"Hallo. Hoe gaat het hier?"	Pre-set
Juvenile	A → Accommodating, B → Cooperating	"Goed hoor."	Choice
Police Officer	Competitive	"Er zijn mensen die zich bedreigd voelen door jullie gedrag."	Pre-set
Juvenile	A → Avoiding, B → Competitive	"Dat hadden we niet door. Waarom is dat onze schuld?"	Choice
Police Officer	Avoiding	"Uhm... Misschien kunnen jullie ergens anders heen gaan?"	Pre-set
Juvenile	Competitive	"Ze gaan zelf maar ergens anders heen! Waarom moeten wij ons altijd aanpassen."	A and B

Table 14: Conversation 7

Who	Strategy	Verbal action	How selected
Police Officer	Avoiding	"hmm..."	Pre-set
Juvenile	A → Competitive, B → Cooperating	"Hallo, wat is er?"	Choice
Police Officer	Competitive	"Wat heb je dit keer gedaan?!"	Pre-set
Juvenile	A → Avoiding, B → Accommodating	"Ik kan het uitleggen meneer."	Choice
Police Officer	Cooperating	"Wat is de reden voor dit luide feest?"	Pre-set
Juvenile	Accommodating	"Alex had zijn diploma gehaald en dat waren we aan het vieren."	A and B

Table 15: Conversation 8

7.5 Participants

The experiment was distributed to friends, family and colleagues at the university. Twenty participants filled in the experiment online on the website. From these twenty participants three were female and the average age of the participants was 29 years. On the question "How much experience do you have with virtual characters?" the participants answered a little bit above average on a five point Likert scale with an average of 3.45 and a standard deviation of 1.16.

7.6 Results

7.6.1 Adjectives

Each participant selected three adjectives for each of the four postures, providing a set of 60 selected adjectives for each posture. The results over all participants for the adjectives that were selected are generally positive. The details of the results for each posture that represented a conflict strategy can be found in Table 16. The adjectives that belong to the matching strategy are highlighted. Furthermore Table 17 shows the same table but now with the strategies that the adjectives represented.

cooperating		accommodating		avoiding		competitive	
Levendig	9	Bescheiden	10	Gesloten	15	Aanvallend	14
Behulpzaam	7	Meegaand	9	Kortaf	8	Dominant	10
Spontaan	6	Verlegen	9	Vastbesloten	6	Brutaal	8
Meegaand	6	Buigzaam	6	Aanvallend	5	Spontaan	6
Brutaal	5	Nederig	5	Brutaal	5	Kortaf	3
Vastbesloten	5	Behulpzaam	4	Dominant	4	Levendig	3
Dominant	4	Attent	4	Schaamteloos	3	Schaamteloos	3
Tolerant	4	Onderdanig	3	Verlegen	3	Meegaand	3
Attent	4	Tolerant	3	Onderdanig	2	Autoritair	3
Autoritair	3	Vastbesloten	2	Autoritair	2	Buigzaam	2
Aanvallend	2	Dominant	2	Nederig	1	Onderdanig	1
Onderdanig	1	Autoritair	1	Spontaan	1	Tolerant	1
Nederig	1	Levendig	1	Afhankelijk	1	Vastbesloten	1
Kortaf	1	Spontaan	1	Bescheiden	1	Bescheiden	1
Verlegen	1	Schaamteloos	0	Attent	1	Behulpzaam	1
Afhankelijk	1	Gesloten	0	Buigzaam	1	Verlegen	0
Gesloten	0	Afhankelijk	0	Levendig	1	Gesloten	0
Bescheiden	0	Brutaal	0	Behulpzaam	0	Afhankelijk	0
Buigzaam	0	Aanvallend	0	Tolerant	0	Attent	0
Schaamteloos	0	Kortaf	0	Meegaand	0	Nederig	0

Table 16: Adjectives selected for posture representing a strategy

cooperating		accommodating		avoiding		competitive	
Cooperating	9	Accommodating	10	Avoiding	15	Competitive	14
Cooperating	7	Accommodating	9	Avoiding	8	Competitive	10
Cooperating	6	Avoiding	9	Cooperating	6	Competitive	8
Accommodating	6	Accommodating	6	Competitive	5	Cooperating	6
Competitive	5	Accommodating	5	Competitive	5	Avoiding	3
Cooperating	5	Cooperating	4	Competitive	4	Cooperating	3
Competitive	4	Cooperating	4	Competitive	3	Competitive	3
Accommodating	4	Avoiding	3	Avoiding	3	Accommodating	3
Cooperating	4	Accommodating	3	Avoiding	2	Competitive	3
Competitive	3	Cooperating	2	Competitive	2	Accommodating	2
Competitive	2	Competitive	2	Accommodating	1	Avoiding	1
Avoiding	1	Competitive	1	Cooperating	1	Accommodating	1
Accommodating	1	Cooperating	1	Avoiding	1	Cooperating	1
Avoiding	1	Cooperating	1	Accommodating	1	Accommodating	1
Avoiding	1	Competitive	0	Cooperating	1	Cooperating	1
Avoiding	1	Avoiding	0	Accommodating	1	Avoiding	0
Avoiding	0	Avoiding	0	Cooperating	1	Avoiding	0
Accommodating	0	Competitive	0	Cooperating	0	Avoiding	0
Accommodating	0	Competitive	0	Accommodating	0	Cooperating	0
Competitive	0	Avoiding	0	Accommodating	0	Accommodating	0

Table 17: Strategy that selected adjectives represented

The top two selected adjectives was correct for every posture. For all strategies except for Avoiding more than 50% of the answers matched with the predetermined adjectives chosen for every strategy as seen in Table 18. For Avoiding the result was 48%. With a large percentage of the other answers

matching with the Competitive strategy it is clear that the Avoiding posture is seen as Hostile, however not as submissive as it was intended to be. The distribution of the answers over the adjectives can be found in Table 19. The numbers represent the percentage of the answers that is given to the first five adjectives, second five adjectives, etcetera. These numbers show that the participants agreed best on the competitive strategy with 68% on the first five adjectives. While the percentage for the cooperating strategy is the lowest with 55% the overall distribution for the adjectives is similar for each strategy. It is interesting to note that the participants had more trouble distinguishing the dominant-submissive axis. Especially for Avoiding you can see in Table 17 that the adjectives for Competitive are high ranked. It seems the Avoiding posture is recognized mostly as hostile.

cooperating	**accommodating**	**avoiding**	**competitive**
51.67%	55%	48.33%	63.33%

Table 18: Answers matching with the strategy

Adjectives selected	**cooperating**	**accommodating**	**avoiding**	**competitive**
1 - 5	55%	65%	65%	68.33%
6 - 10	33.33%	26.67%	23.33%	23.33%
11 - 15	10%	8.33%	8.33%	8.33%
16 - 20	1.67%	0%	3.33%	0%

Table 19: Spread of answers over the available adjectives

7.6.2 Conversations

Overall the results from the choice moments in the conversations were clear with 22% for model A (the complementing strategy) and 78% for model B (PeCoAPS). However looking at the individual results for each moment where a participant had to choose the results shows clear deviations. Details about these deviations are described below. The results for each moment can be found in Figure 27. With even the lowest individual result being still at 55% in favour of PeCoAPS no statistical test is required to show that the participants overall favoured option B (PeCoAPS).

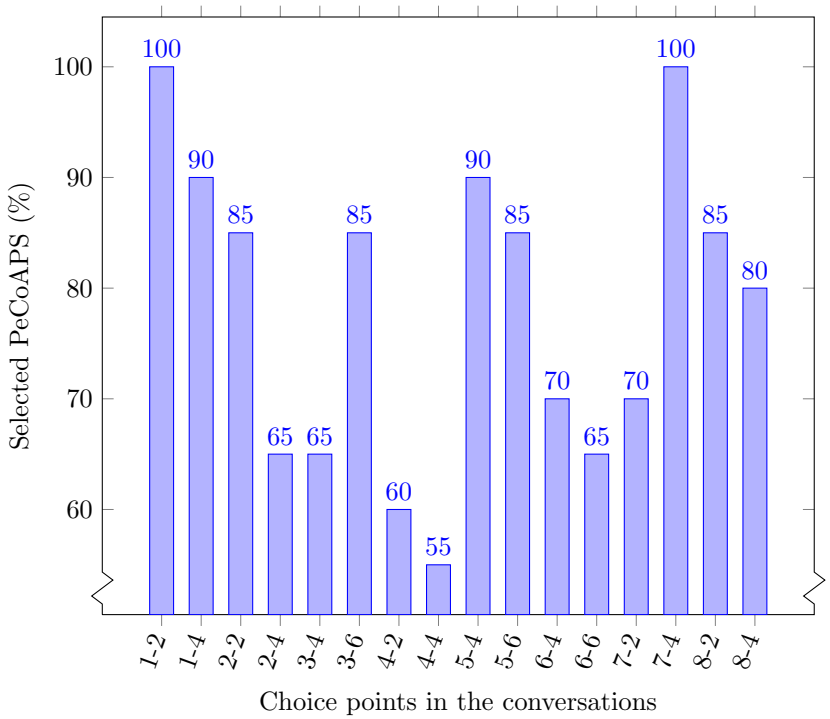


Figure 27: Individual results for every choice moment for option B (PeCoAPS).

7.6.3 Error Analysis

Since the individual results per choice moment range from 55% to 100% for Option B, we looked at the five lowest results to try and explain why they were less convincing. The specific images are numbered as 2-3, this is conversation 2 and image 3. The variables describing the conversation followed by what Adrie said before the choice moment and the options of the choice are listed below.

Conversation 2
The description of Barry tells us: his personality is Accommodating, his APS is Avoiding.

- 2-3 Adrie: (Accommodating) → "I was sent here because there were complaints about the noise."
- 2-4 Barry: Cooperating (Model A) or Accommodating (Model B) → 65% for B.

Conversation 3
The description of Barry tells us: his personality is Avoiding, his APS is Accommodating.

- 3-3 Adrie: (Accommodating) → "Can you guys be more quiet?"
- 3-4 Barry: Cooperating (Model A) or Accommodating (Model B) → 65% for B.

Conversation 4
The description of Barry tells us: his Personality is Avoiding, his APS is Competitive.

- 4-1 Adrie: (Accommodating) → "Hello."
- 4-2 Barry: Cooperating (Model A) or Competitive (Model B) → 60% for B.
- 4-3 Adrie: (Cooperating) → "Somebody did not throw his soda can in the bin."

- 4-4 Barry: Accommodating (Model A) or Avoiding (Model B) → 55% for B.

Conversation 6
The description of Barry tells us: his Personality is Competitive, his APS is Cooperating.

- 6-5 Adrie: (Competitive) → "It is outrageous that people pollute other people's property like that!"
- 6-6 Barry: Avoiding (Model A) or Competitive (Model B) → 65% for B.

For the moments in conversation 2, 3 and 6 it seems the participants that voted for option A did not want to mirror the posture of the police officer. Furthermore for the moments in conversation 4 it seems the participants that voted for option A focused mainly on the words of the police officer. I believe they had the idea that he was reasonable and they wanted to cooperate with the police officer instead of responding in a hostile manner. It seems they acted more from their own perspective than from the perspective of the juvenile. Furthermore the posture for competitive and cooperative might be harder to distinguish, this could also have played a role for some participants. Screenshots from this part of conversation 4 can be found in Figure 28-31.

Figure 28: A screenshot of 4-1 (the first image of conversation 4).

Figure 29: A screenshot of 4-2 (the second image of conversation 4).

Figure 30: A screenshot of 4-3 (the third image of conversation 4).

Figure 31: A screenshot of 4-4 (the fourth image of conversation 4).

7.6.4 Believability

The participants were asked to rate how believable the performance of Barry was and to write down what was (un)believable about him. The believability rating on the 5 points Likert-scale resulted in an average of 3.40 with a standard deviation of 0.66. The same was done for Adrie (the police officer). The believability rating for Adrie had an average of 3.00 with a standard deviation of 1.10. In our hypothesis we said we wanted to know whether Barry was more believable than Adrie. With the average believability of 3.40 for Barry and 3.00 for Adrie this is the case. We statistically tested these two variables to check that the results are not just coincidental. Performing a paired t-test on the results of the believability of Barry and Adrie resulted in p=0.134 which is unfortunately not below 0.05 and therefore not significant, so we cannot say with certainty that Barry was more believable than Adrie. Since the 'experience with virtual characters' value was the only value from the demographics of the participants that used a Likert-scale, we wanted to compare this value with the believability to test for correlations. We checked for a correlation between the believability scores and the experience with virtual agents value of the participant which had even less success with probabilities above 0.20. This implies that there is no significant correlation between the experience with virtual agents and the believability of the characters.

The open questions where the participants wrote down what they thought was (un)believable about Adrie and Barry did provide us with useful information. For both Barry and Adrie they said the poses were sometimes forced and too extreme. Some participants felt the amount of expressions was limited. For Barry they said mostly Barry was convincing in his responses to what Adrie said. The behaviour of Barry sometimes did not conform with how he was described. The poses were sometimes ambiguous since the facial expression was missing. For Adrie the participants said they looked mostly at Barry. They did not look much at Adrie and how believable he was. Some participants noted that Adrie sometimes said things they would not expect from a police officer. Adrie responded indecisively sometimes which did not fit with his role.

7.7 Discussion

In this user experiment we first matched images of the different postures with adjectives that describe the conflict strategies. We had the following hypothesis about this: *Participants can match the postures with adjectives that describe the conflict strategies.* The individual adjectives were mostly distributed as expected. With the top two adjectives for each posture being correct we were positive

that the participants can match the postures with the corresponding conflict strategies, satisfying the first hypothesis. However, it is interesting that five participants rated the Avoiding posture as 'aanvallend' (offensive) and 'brutaal' (cheeky) which belong to Competitive. However this was the first image shown which means the participants had nothing to compare it with yet. When they looked at the real Competitive posture afterwards they noticed that the Avoiding posture was actually not that dominant. In further research it would be better to give the participants the option to compare all the postures before rating them.

Due to the fact that the facial expression of the characters was the same with all postures the participants had sometimes trouble judging the postures. Furthermore some divergent judgements could have been due to the fact that the participants had no way to compare the image of the posture to the other images since they were not allowed to go back in this part of the experiment. Still, considering this limitation the results are positive and it is interesting to see that the participants had more trouble with the agency axis than the communion axis. Maybe submissive behaviour can be recognized in the facial expression or has other factors that we did not use. The facial expression was unfortunately not completely neutral, the slightly hostile facial expression could have made it harder to judge the cooperative postures. This could also have made it harder to recognize submissive behaviour.

In the second part of the user experiment we evaluated PeCoAPS using several conversation where the participant could choose several times between different postures. We wanted to confirm the hypothesis: *Participants prefer the use of PeCoAPS over the complementing strategy.* For all of the choice moments over 50% of the participants chose option B which would mean that in general the participants favoured PeCoAPS over the complementing strategy, satisfying the second hypothesis. Further investigation on the five moments where the result was below 70% gave me the idea that at this moment in the conversation the participants either gave a large weight to the verbal message of the police officer or they did not want to mirror the posture of the police officer, ignoring the description of Barry at this moment. The police officer was friendly during these moments resulting in them to choose the cooperative option. It seems they did not want to select the same posture as the police officer; they selected the complementing strategy instead. When there are more than four different postures the participants will probably not have the problem of having to mirror the exact posture of the police officer.

After the conversations the participants rated the believability of the characters. The hypothesis we had here: *Participants rate the juvenile as more believable than the police officer.* Unfortunately Barry was not rated significantly more believable than Adrie. We cannot confirm the third hypothesis. Since the participants were only allowed to choose the posture for Barry they probably had the idea their choice was believable. The believability depended on the options they could choose from and what they actually chose. However the believability was challenged when the verbal text of Barry was not what they expected. Since the believability was probably a bit biased towards how they envisioned Barry the results for the Likert scale questions only give an indication of how the participants experienced the characters. However the open questions showed that a follow up experiment will require facial expressions to make the characters more believable.

Some participants felt limited by the fact that they could only choose between two images and they also said that a total of four active postures is not enough to express yourself. Since this experiment was an abstraction of what posture could look like it is not strange that participants had trouble with the extreme shifts in posture. For a follow-up experiment it would be important to make the changes in posture more subtle, to look at options to blend the postures into each other and to make longer interactions. The facial expressions and verbal communication were not the focus of this experiment. However they do play a huge role in life and therefore are required for realistic virtual characters. This experiment did not include the mood component that is discussed in the model. We believe

that facial expressions could be used to visualize the mood of the virtual character to make it more expressive.

8 Discussion

In this section we will reflect on what we have done and what we can say about the results. We discuss the limitations of the current work in section 8.1. We will also discuss the possibilities for future work in section 8.2. We briefly discuss the parts of the simulation that we did not focus on in our research.

8.1 Limitations of the current work

For the scenario there are still a lot of parts that we have not looked at in this study since we only focused on the conflict between the loitering juveniles and the police officer. The complete scenario should give the player options to start slowly and learn the basics about the scenario and train different approaches.

From our interview at the police station in Enschede we picked up some things about the current methods that are used and how things are going on the streets. However we did not personally visit the police academy to find out what the police officers in training learn about conflict on the streets. However other people in our project group have had contact with the police academy to discuss their training schedule and told us that they only spend a few days on theory. With insight into the actual material that the students at the police academy get we could provide a better fitting simulation that complements the theory they learned.

A large part of our model that was used in the experiment is theoretical. We have not implemented it in a virtual agent yet. Some parts still need more work and validation before they are ready for implementation. For example the Active Pursuit Strategy will require a function to convert the goals of the character agent into active pursuit strategies that are based on cooperativeness and assertiveness. We only used Extraversion and Agreeableness from the Five Factor model in our model. The other factors might be usable for thought processes in the character agent as well. For example, when using multiple juveniles as a group the Openness and Conscientiousness factors could be relevant for group members to accept the choices of the character agent and the character agent could be depending on other group members. The mood still requires more research since it is supposed to be the bridge between short term reactive behaviour (emotions) and long term behavioural patterns (personality). Especially the effects that the mood has on the emotions and personality are still worth looking at. Furthermore the mood still requires an implementation as well. We still need a method to appraise an action that is performed by another character and derive the impact on the mood from this action. This could be combined with a direct emotional response. We would prefer a computational method for this appraisal step. We have not looked into story arcs and the methods to build conflict and finally resolve it with a fitting conflict resolution. When it comes to the strategy selection phase there might be other relevant factors than the personality, active pursuit strategy and complementing strategy.

For the action selection we found out that it is hard to create a coherent conversation with a small predetermined set of actions. We noticed that the problem was mostly with the speech acts that require context to make sense. The character agents might need to share information to model the dialogue. Since we have not worked with natural language processing or generation we created the whole conversation up front in for our experiment to test the strategy selection model.

The results from our visualization experiment and the adjectives in the strategy selection experiment are generally positive when it comes to recognizing the conflict strategies in the postures. It was hard in the visualization experiment to find the right posture for the avoiding strategy but it seems that the new posture that was created based on the results was clear enough for the participants of the strategy selection experiment to match with the right adjectives. Unfortunately the participants still had trouble recognizing the submissive behaviour. It seems the communion axis is easier to recognize in physical behaviour than the agency axis. The strategy selection experiment results were promising

and suggest that the model is currently on the right track. When it comes to testing believability the results show us that the evaluation of the strategy selection model was probably too early to test the believability of the character agents. Although the results from the believability questions were not significant the comments from the participants were useful.

8.2 Future work

The scenario that we used still has a lot of options for future research and implementation. We have not looked into the behaviour of the bystanders and possible other police officers at the station. Furthermore the scenario could provide options to interrogate specific juveniles at the police station. These one-on-one interrogations can take much longer than a conversation on the street and probably require an extensive model for the character agent that represents the juvenile [49]. We cooperated on an interrogation training research project [6] for which we looked at a corpus of interrogation training videos with actors which we used to classify the important factors in interrogations. We have already found some theories that are applicable for both suspect interrogations and conversations with juveniles on the street. Since for both the interrogation and our application we require a computational model to generate believable behaviour there is still the possibility for a generic model that can be used as the underlying base for both implementations.

We propose a closer look at the material that the police officers use at the police academy. Matching this theory with practice in the serious game would provide the best learning experience. Asking the police officers, that graduated from the police academy and are working on the streets for a short while, what they missed in the theory at the police academy could provide new information as well about missing knowledge.

We have also only scratched the surface for group behaviour, which could provide important aspects for the simulation such as a group stance and group leaders. We believe that when the character agents are capable of reasoning about themselves this could be a good next step to make the situations more realistic. We could use the theory about group dynamics [21] that was written for FAtiMA as inspiration. They describe the important factors for creating groups, controlling them and being respected in a group. These factors could be useful for portraying situations where a character is the leader of the group or has the feeling that he does not belong with the group. Such situations can be important for a police officer to notice and act on. We believe the communication between the members of the group could be an interesting aspect to look at. Communication that is not directly related to the conversation or directed at the police officer could be a useful addition.

We have used emotion in the appraisal phase to evaluate the actions of other characters. For future work we will have to look at expressing emotions instead of only reasoning about them. This can be implemented comparable to the reactive layer in FAtiMA [4] that uses a set of emotional rules that affect emotional variables. Furthermore it could be useful to look at double appraisal [3], described in section 3.2, as well for the character agents. Double appraisal means the character agent tries to select an action that is not only best for himself but also for the others in the conversation. This could make the characters more believable and the results of the double appraisal phase could even be provided to the human player after the simulation to give insight into the characters when evaluating their performance. It probably is useful to know why a character reacted the way it did. When it comes to conflict we have looked mostly at the local behaviour and the mental processes to consider a fitting response. The balance between the personality, active pursuit strategy and complementing strategy also has not been evaluated yet and requires future work, although the good results from the evaluation show that this is the right direction. The weight of the personality on selected behaviour could be higher than the complementing strategy for example. Furthermore we are using traits such as personality on a very direct level. Since we are only dealing with very short conversations we are using personality as a factor to provide the state of mind of the character instead of using it to explain

long term behaviour. However the consistency for a character's personality on the longer term is an interesting aspect for future work.

For the visualizations of the conflict strategies we created four postures plus the idle posture. We only used snapshots of the conversation in our comic form. Fluid motions and transition behaviour will make it much more complicating. In future work the characters could be expanded with visible emotions and possibly animations (instead of static behaviour) that could be created with motion capturing equipment.

Since our study is still in the early phase of the AGENT project we have not created a working prototype yet that implements all the aspects of our model. We implemented many aspects like the strategy of the police officer and the verbal expressions with static values. In a working prototype we will need an interface for the user to select actions for the police officer and possibly natural language generation to create verbal expressions for the character agents. This language generation, more generic action generation, still requires a lot of research to provide the players and characters with enough action options while keeping the story believable.

9 Conclusion

In this thesis we did our best to answer the question: *How can we create an agent-based model for conflict behaviour intended for character agents in a serious game for police officers?* We started with describing the context of our work in chapter 2. We looked at our scenario where one or two police officers are sent to a disturbance caused by a group of juveniles. We focused on the actual conversation between the police officer and the juveniles where the police officer is tasked to resolve the conflict. We answer our first sub question *What is the training that police officers get to deal with conflict on the streets?* with information from our interview. We interviewed police officer John who is a youth coordinator in Enschede. We talked with him about the groups of juveniles in Enschede. He explained us that they used a system to classify the groups of juveniles and that they receive only a few days of theoretical training about how to deal with juveniles on the police academy. This is followed by pairing up with a more experienced police officer to learn in practice. They nowadays have some extra courses where police trainers re-enact scenarios with the help of actors to get a better understanding about these specific situations. This information confirmed for us that the police officers want and need more practical training. We believe that a serious game is a affordable solution for this problem that combines theory and practice and enables police officers to train their social skills in a protected environment.

The next question that we answered was: *How do other related systems work with conflict?* We looked in the literature at several prominent interactive storytelling systems in chapter 3. We looked at their methods to appraise actions, handle conflict and deal with emotions. We used this information to identify the important theories that we required to create our own model. We also answered the question *What theories are important to describe interpersonal behaviour?* with information from the literature in chapter 4. We described theories about personality and looked into one of the more prominent models called the Five-Factor Model [12]. The Five-Factor Model which is also known as the 'Big Five' describes personality using five basic dimensions. We also described theory about interpersonal stance. We looked at the Interpersonal Circumplex [19]. The interpersonal circumplex uses a scale from hostile to friendly (cooperativeness) and a scale from dominant to submissive (assertiveness) to display the interpersonal stance. We discussed the theory from Orford [34] that states that on the assertiveness scale opposites attract and on the cooperativeness scale equality attracts. He calls this complementing behaviour. Furthermore we discussed a theory of conflict. According to Thomas [45] this are five approaches to manage conflict. They are competition, collaboration, avoidance, accommodation and compromise. Next we discussed the cognitive theory of emotions [35] which classifies the emotions into groups. Finally we describe the belief-desire-intention (BDI) model [17] for practical reasoning agents. The model uses beliefs to represent knowledge about the world, desires to represent the motivations of the agent and intentions to represent the commitment of the agent. We gathered all these theories to create our own agent-based model for the character agents representing the loitering juveniles in our scenario.

In chapter 5 we came back to our main question: *How can we create an agent-based model for conflict behaviour intended for character agents in a serious game for police officers?*
I presented my model which uses three phases. In the action appraisal phase the character agent looks at his own desires or goals and the emotions from the cognitive theory of emotions to appraise the actions of other characters. This could have an effect on the mood of the character. This is followed by the strategy selection phase where the character agent selects a conflict strategy (from the set of Competitive, Avoiding, Accommodating and Cooperating) based on the values of his Personality, the Complementing Strategy and his Active Pursuit Strategy (PeCoAPS). The Personality is based on the Extraversion and Agreeableness factors from the Five-Factor Model. The Active Pursuit strategy is based on the active pursuit goal which is the intention of the character agent. The complementing strategy is based on the complementing behaviour described by Orford. Finally in the action selection phase the selected conflict strategy and the current mood are used to select a fitting action. After

creating our agent-based model we wanted to evaluate it in a user experiment where we presented the participants with several small conversations between a police officer and a juvenile. We wanted to make the use of conflict strategies explicit by visualizing them in the posture of the juvenile. Since there were no usable postures available yet we created our own.

In chapter 6 we answer part of the question: *How do we evaluate a character agent with conflict behaviour in a user experiment?* We looked into the option of visualizing the different conflict strategies in posture and non-verbal behaviour for virtual characters. We created a posture for each of the four conflict strategies by performing a user experiment where participants rated three different postures for each strategy that matched the criteria of Ravenet's research [40]. The results of this experiment provided us with a good posture for Competitive, Cooperative and Accommodating behaviour. For the Avoiding behaviour we created a new posture that combined some of the aspects of the three tested options based on comments from participants.

We continued with evaluating the character agent's conflict behaviour in chapter 7. The postures that were provided in the preliminary experiment were used in the evaluation of the strategy selection model. We created a virtual world that represented a park where the police officers and juveniles would meet. We evaluated the new postures by letting the participants match them with adjectives that describe the conflict strategies. Using the scenario in the park we evaluated the strategy selection phase of our model with eight small conversation that consisted of screenshots from the virtual world. We tested our strategy selection model against a base line that was represented by just the complementing strategy. We did not want to use a random strategy for the police officer, because we believe randomizing behaviour is not believable. The participants had to choose between two images representing the complementing strategy and PeCoAPS twice in each conversation. With the results from our experiment we answer the last sub question: *How does the model perform in a user experiment?* The adjectives were mostly distributed as expected with the top two selected adjectives being correct for each posture. However it seemed the participants had more trouble recognizing submissive behaviour. The results for the choice moments in the conversations where clear with 78% of the selected images being PeCoAPS. We analysed the individual results that were below 70% and concluded that for some of them the verbal text of the character played a role in the decision. Finally we asked the participants to rate the believability of the police officer and the juvenile. Unfortunately these ratings showed no significant correlations. We believe the experiment was too early in the development process to properly test believability.

Summarizing, in this research I made the following contributions. I have listed my work in chronological order below.

Interview I performed the interview with police officer John together with Jeroen Linssen. This interview gave us insight into the methods that the police officers learn to handle conflict on the streets and the types of interaction that they have with the juveniles. Multiple short conversations on the street to establish a positive relation with the juveniles and sometimes hours long conversations at the station with an individual to discuss his situation. The results of the interview are described in section 2.2.

Model A new agent-based model for appraisal, strategy selection and action selection that can be used for character agents that interact in conflict situations. The model is described in chapter 5

Virtual Environment I created the virtual environment for the experiment in the Unity game engine. The virtual environment contains a small park in a city and can be used in other experiments and could also be used in the LOITER game for a front-end that is developed in Unity. The virtual environment is described in section 7.1.

Preliminary Experiment The preliminary experiment with 7 participants was performed to find fitting postures that match the four conflict strategies. This experiment resulted in three

fitting postures for three of the four conflict strategies and a good direction for the fourth posture. The methods and the resulting postures are described in chapter 6.

Visualizations I rigged the postures for the four conflict strategies in Blender. These postures can be used as a baseline for future animations. The rigging process is also described in section 7.1.

Evaluation of agent based model The model was evaluated with 20 participants to see how it performed compared with the complementing strategy. The results show that the model performs well, but it still requires work when it comes to emotions, more subtle changes in the posture and selecting the appropriate actions. This experiment and the results are described in chapter 7.

Although multiple parts of the model still require validation and more work, the strategy selection phase performed well in the evaluation. With the results of our experiments showing that our strategy selection model is performing better than just the complementing strategy, we believe that we made a step in the right direction.

10 Bibliography

[1] Thijs Alofs, Mariët Theune, and Ivo Swartjes. A tabletop board game interface for multi-user interaction with a storytelling system. In *Proceedings of The Fourth International Conference on Intelligent Technologies for Interactive Entertainment*, pages 123–128, 2011.

[2] Ruth Aylett. Narrative in virtual environments-towards emergent narrative. In *Proceedings of the AAAI fall symposium on narrative intelligence*, pages 83–86, 1999.

[3] Ruth Aylett and Sandy Louchart. If i were you: double appraisal in affective agents. In *Proceedings of the 7th international joint conference on Autonomous agents and multiagent systems-Volume 3*, pages 1233–1236. International Foundation for Autonomous Agents and Multiagent Systems, 2008.

[4] Ruth Aylett, Sandy Louchart, Joao Dias, Ana Paiva, Marco Vala, Sarah Woods, and Lynne Hall. Unscripted narrative for affectively driven characters. *Computer Graphics and Applications, IEEE*, 26(3):42–52, 2006.

[5] Christina Bartl and Dietrich Dörner. Psi: A theory of the integration of cognition, emotion and motivation. In *Proceedings of the 2nd European Conference on Cognitive Modelling*, pages 66–73. DTIC Document, 1998.

[6] Merijn Bruijnes, Jeroen Linssen, Rieks op den Akker, Mariët Theune, Sjoerd Wapperom, Chris Broekema, and Dirk Heylen. Social behaviour in police interviews: Relating data to theories. *Conflict and communication*, 2013. In Press.

[7] Henrique Campos. Conflict: Agents in conflict situations. *Msc thesis, Instituto Superior Técnico (Lisbon)*, 2012.

[8] Henrique Campos, Joana Campos, Carlos Martinho, and Ana Paiva. Virtual agents in conflict. In *Intelligent Virtual Agents*, pages 105–111. Springer, 2012.

[9] Joana Campos, Henrique Campos, Carlos Martinho, and Ana Paiva. A serious game for teaching conflict resolution to children. In *Intelligent Tutoring Systems*, pages 705–706. Springer, 2012.

[10] Yun-Gyung Cheong, Rilla Khaled, Corrado Grappiolo, Joana Campos, Carlos Martinho, Gordon PD Ingram, Ana Paiva, and Georgios Yannakakis. A computational approach towards conflict resolution for serious games. In *Proceedings of the 6th International Conference on Foundations of Digital Games*, pages 15–22. ACM, 2011.

[11] COMMIT. Interaction for universal access - socially intelligent agents in serious gaming environments. `http://commit-nl.nl/projects/wp-packages/socially-intelligent-agents-in-serious-gaming-environments`, June 2014.

[12] John M Digman. Personality structure: Emergence of the five-factor model. *Annual review of psychology*, 41(1):417–440, 1990.

[13] D Christopher Dryer. Getting personal with computers: how to design personalities for agents. *Applied Artificial Intelligence*, 13(3):273–295, 1999.

[14] Henk Ferwerda. *Shortlistmethodiek in 7 stappen*. Bureau Beke, 2009. Onderdeel van het Masterplan Jeugdgroepen Nederlandse Politie.

[15] Blender Foundation. Blender. `http://www.blender.org/`, August 2014.

[16] Patrick Gebhard. Alma: a layered model of affect. In *Proceedings of the fourth international joint conference on Autonomous agents and multiagent systems*, pages 29–36. ACM, 2005.

[17] Michael Georgeff, Barney Pell, Martha Pollack, Milind Tambe, and Michael Wooldridge. The belief-desire-intention model of agency. In *Intelligent Agents V: Agents Theories, Architectures, and Languages*, pages 1–10. Springer, 1999.

[18] Lewis R Goldberg. The development of markers for the big-five factor structure. *Psychological assessment*, pages 26–42, 1992.

[19] Michael B Gurtman. Exploring personality with the interpersonal circumplex. *Social and Personality Psychology Compass*, 3(4):601–619, 2009.

[20] Lixing Huang, Louis-Philippe Morency, and Jonathan Gratch. Virtual rapport 2.0. In *Intelligent virtual agents*, pages 68–79. Springer, 2011.

[21] Naziya Hussaini and Ruth Aylett. An idea for modelling group dynamics in autonomous synthetic characters. *Social.PATH*, pages 30–34, 2013.

[22] Timothy A Judge, Joyce E Bono, Remus Ilies, and Megan W Gerhardt. Personality and leadership: a qualitative and quantitative review. *Journal of applied psychology*, 87(4):765, 2002.

[23] Janice R Kelly and Sigal G Barsade. Mood and emotions in small groups and work teams. *Organizational behavior and human decision processes*, 86(1):99–130, 2001.

[24] Michael Kipp, Thomas Dackweiler, and Patrick Gebhard. Designing emotions - an empirical approach to realistic affect simulation. *KI - Künstliche Intelligenz*, 25 - Special Issue on Emotion and Computing:205–211, 2011.

[25] Timothy Leary. Interpersonal diagnosis of personality; a functional theory and methodology for personality evaluation. 1957.

[26] Jeroen Linssen and Thomas de Groot. Agent: Awareness game environment for natural training. In *Proceedings of the International Conference on the Foundations of Digital Games*, pages 433–434. Society for the Advancement of the Science of Digital Games, 2013.

[27] Jeroen Linssen, Thomas de Groot, and Merijn Bruijnes. Scenario: Loitering juveniles. *COMMIT WP5 Deliverable*, 2012.

[28] Jeroen Linssen, Thomas de Groot, and Mariët Theune. Serious game prototype: Agent. *COMMIT WP4 Deliverable*, 2013.

[29] Sandy Louchart and Ruth Aylett. Building synthetic actors for interactive dramas. In *Proceedings of the AAAI Fall Symposium on Intelligent Narrative Technologies*, pages 63–71, 2007.

[30] Robert R McCrae and Oliver P John. An introduction to the five-factor model and its applications. *Journal of personality*, 60(2):175–215, 1992.

[31] Mixamo. Mixamo animations. `http://www.mixamo.com/motions/`, August 2014.

[32] Muaz Niazi and Amir Hussain. Agent-based computing from multi-agent systems to agent-based models: a visual survey. *Scientometrics*, pages 479–499, 2011.

[33] Magalie Ochs, Brian Ravenet, and Catherine Pelachaud. A crowdsourcing toolbox for a user-perception based design of social virtual actors. *International Workshop "Computers are Social Actors" (CASA), Intelligent Virtual Agent Conference (IVA)*, 2013.

[34] Jim Orford. The rules of interpersonal complementarity: Does hostility beget hostility and dominance, submission? *Psychological Review*, pages 365–377, 1986.

[35] Andrew Ortony. On making believable emotional agents believable. *Emotions in Humans and Artifacts*, pages 189–211, 2002.

[36] Andrew Ortony, Gerald L Clore, and Allan Collins. *The cognitive structure of emotions*. Cambridge University Press, 1990.

[37] Catherine Pelachaud and Isabella Poggi. Subtleties of facial expressions in embodied agents. *The Journal of Visualization and Computer Animation*, pages 301–312, 2002.

[38] Julie Porteous, Marc Cavazza, and Fred Charles. Applying planning to interactive storytelling: Narrative control using state constraints. *ACM Trans. Intell. Syst. Technol.*, pages 10:1–10:21, 2010.

[39] Anand S Rao and Michael P Georgeff. Bdi agents: From theory to practice. In *ICMAS*, volume 95, pages 312–319, 1995.

[40] Brian Ravenet, Magalie Ochs, and Catherine Pelachaud. From a user-created corpus of virtual agent′s non-verbal behavior to a computational model of interpersonal attitudes. In *Intelligent Virtual Agents*, pages 263–274. Springer Berlin Heidelberg, 2013.

[41] Danny Rouckhout and R Schacht. Ontwikkeling van een nederlandstalig interpersoonlijk circumplex. *Diagnostiekwijzer*, 4:96–118, 2000.

[42] Timothy W Smith, Bert N Uchino, Cynthia A Berg, Paul Florsheim, Gale Pearce, Melissa Hawkins, and H Yoon. Associations of self-reports versus spouse ratings of negative affectivity, dominance, and affiliation with coronary artery disease: where should we look and who should we ask when studying personality and health? *Health Psychol*, 27(6):676–684, 2008.

[43] Ivo Swartjes. *Whose story is it anyway?: how improv informs agency and authorship of emergent narrative*. PhD Thesis, University of Twente (Enschede), 2010.

[44] William Swartout. Lessons learned from virtual humans. *AI Magazine*, 31(1):9–20, 2010.

[45] Kenneth W Thomas. Conflict and conflict management: Reflections and update. *Journal of Organizational Behavior*, 13(3):265–274, 1992.

[46] David Traum, Stacy C Marsella, Jonathan Gratch, Jina Lee, and Arno Hartholt. Multi-party, multi-issue, multi-strategy negotiation for multi-modal virtual agents. In *Intelligent Virtual Agents*, pages 117–130. Springer, 2008.

[47] Unity. Unity - game engine. `http://unity3d.com/`, August 2014.

[48] Frederik Vaassen, Jeroen Wauters, Frederik Van Broeckhoven, Maarten Van Overveldt, Walter Daelemans, and Koen Eneman. delearyous: Training interpersonal communication skills using unconstrained text input. *Proc. of ECGBL*, pages 505–513, 2012.

[49] Sjoerd Wapperom. Computational modelling of suspect behaviour in police interviews. *Msc thesis, University of Twente (Enschede)*, 2014.

[50] Stephen G Ware and R Michael Young. Modeling narrative conflict to generate interesting stories. *Proc. of AIIDE*, 10, 2010.

[51] R Michael Young. An overview of the mimesis architecture: Integrating intelligent narrative control into an existing gaming environment. In *The Working Notes of the AAAI Spring Symposium on Artificial Intelligence and Interactive Entertainment*, pages 78–81, 2001.

Appendices

A Dutch interview with police officer John

A.1 Questions

ALGEMEEN
1) Wat voor klachten krijg je binnen als wijkagent?
2) Hoe groot zijn de groepen hangjongeren die je tegen komt?
3) Heb je concrete verhalen of verslagen die we mogen inzien?
4) Wat voor terugkoppeling gebruiken jullie na contact met jongeren?
5) Wat weten jullie over de achtergrond van hangjongeren?
6) Gebruiken jullie deze informatie ook als jullie met ze praten?

GESPREKKEN
7) Hoe open je een gesprek met de jongeren?
8) Hoe reageren de jongeren?
9) Hoe reageer je op bedreigingen?
10) Hoe lang duurt een gesprek?
11) Zijn er verschillende fases in een gesprek?

OPLOSSINGEN
12) Wat probeer je te bereiken als je op een groep jongeren af stapt?
13) Wat heb je te bieden aan oplossingen als jongeren overlast veroozaken?

SCENARIO BESCHRIJVING
Er hangt een groep van 6 jongeren rond in de winkelstraat. Ze rijden hard op hun scooters en gooien blikjes en andere verpakkingen gewoon op straat. Er is net een melding binnengekomen dat er een prullenbak vernield is. Agent Henk wordt gevraagd er langs te gaan.

Hieronder volgen twee scenarios die voortborduren op deze setting: n scenario met een positieve en n met een negatieve afloop van het conflict. Dat wil zeggen, bij scenario 1 wordt er een oplossing gevonden, bij scenario 2 niet.

SCENARIO 1
Agent Henk loopt vol zelfvertrouwen naar de groep hangjongeren toe. Na een korte begroeting "Hallo jongens." neemt hij een rustige houding aan. Henk zegt vervolgens:"Kunnen we jullie ergens mee helpen?" Eén van de hangjongeren kijkt schichtig om zich heen en vraagt vervolgens aarzelend: "Wat is het probleem, meneer?" Met zijn handen in zijn zakken en zijn schouders ophalend zegt de hangjongere: "Tja, jullie moeten toch ook wat te doen hebben tijdens het werk." "Moeten we de moeite nemen om later nog eens langs te komen, of kunnen we jullie vertrouwen hier weg te gaan?" vraagt Henk, de jongere streng aankijkend. De jongere kijkt naar de grond en zegt zachtjes: "We zullen het niet meer doen..." Henk is overtuigd dat de jongens serieus zijn en oprecht spijt hebben: "Jullie krijgen de rekening nog wel jongens." "OK, OK, we betalen de schade..." zegt de hangjongere, schuin wegkijkend.

SCENARIO 2
Agent Henk loopt vol zelfvertrouwen naar de groep hangjongeren toe. Na een korte begroeting "Hallo jongens." neemt hij een agressieve houding aan en zegt: "Kunnen jullie niet ergens anders heen gaan?" De hangjongeren gaan in een lijn tegenover Henk staan en kijken verontwaardigd. Eén van de hangjongeren zegt met een luide stem: "Hebben jullie niet iets beters te doen? Ga boeven vangen!" "Ho ho," zegt Henk, en grijpt naar zijn walkietalkie, "wat zijn jullie van plan? Ik hoef toch

niet back-up erbij te halen?" Een jongen in de groep maakt aanstalte om weg te rennen. Hij heeft blijkbaar wat te verbergen. Henk ziet dit gebeuren en doet een stap in de richting van de jongen. Henk wijst naar de jongen en zegt: "Meekomen naar het politiebureau jij. De rest kan gaan." Harry is niet van plan om het hier bij te laten en zijn vrienden beginnen rumoerig te worden en nemen een aggresieve houding aan. Een jongen zegt op een luide toon: "Als je nu weg gaat zullen we je niet in elkaar slaan. Laat hem met rust!" "OK, OK," zegt Henk, en neemt een paar stappen terug, "We zullen jullie wat ruimte geven." De jongen heeft door dat Henk geschrokken is en ziet nu zijn kans om hem te intimideren. Hij trekt zijn mes en schreeuwt: "Laat ons met rust of ik steek je neer. Blijf van mijn vrienden af!"

THEORIE
14) Wat voor theorie hebben jullie gehad over conflictgedrag?
15) Wat weet je over conflict strategin?
16) Herken je de vormen van conflictgedrag?
Voorbeelden:
Concurrerend: "Als je nu weg gaat zullen we je niet in elkaar slaan. Laat hem met rust!"
Samenwerkend: "Wat is het probleem, meneer?"
Ontwijkend: Een jongen in de groep maakt aanstalte om weg te rennen.
Meegaand: "OK, OK, we betalen de schade..."

A.2 Transcript answers

11 November 2013 Politie Bureau Zuid Enschede.

Introductie: Hoe gaat John een gesprek in met jongeren op straat?
Samengevat maakt John weinig gebruik van de theorie en doet hij zijn werk vooral op gevoel. Hij probeert zich in te leven in de situatie van de jongeren en probeert de jongeren te laten inleven in de situatie van anderen. Bij grotere groepen is het vaak het beste om de leiders in de groep te zoeken en met hun indvidueel afspraken te maken. Het zijn zowel jongens als meisjes en die worden door de politie gelijk behandeld.
In Enschede zijn er 13 Jeugdgroepen bekend bij de politie waarvan er 2 crimineel zijn. Ze gebruiken de baker-shortlist om jeugdgroepen te clasifiseren. De wijkteams proberen aan 2 groepen extra aandacht te besteden.
De jeugdagenten die met de jongeren omgaan hebben Politile jeugdtaak niveau 4 gedaan.
1) Wat voor klachten krijg je binnen als wijkagent?
Het gaat meestal om overlast op bekende hangplekken. De jongeren zijn luidruchtig maken rotzooi en zijn intimiderend tegenover andere mensen in hun omgeving. Ook zijn er groepen die verkeersoverlast veroorzaken met scooters. Als de politie na het delict aan komt zullen de jongeren vaak ontkennen, zonder bewijs kan de politie ze niks maken. Daarom kiest de politie er vaak voor om de groepen in burger te bestuderen en de ouders van de jongeren erbij te betrekken. De wijkagenten gaan vaak op bezoek bij de jongeren en hun ouders thuis om daar de situatie te bespreken. De ouders weten meestal niet wat hun kinderen doen op straat. Verder bekijken ze ook de thuissituatie om eventueel jeugdzorg in te schakelen.

2) Hoe groot zijn de groepen hangjongeren die je tegen komt?
De groepen bestaan in Enschede uit ongeveer 7 tot 20 personen. De leeftijd van de jongeren ligt tussen de 12 en 17 jaar en voor de criminele groepen zijn het ook jongeren van 18+.

3) Heb je concrete verhalen of verslagen die we mogen inzien?
De wijkagenten voeren na contact met de jongeren een korte samenvatting in op de computer. Deze informatie wordt gedeeld met jeugdzorg en de jeugdwerkers. Hiervoor moeten we contact opnemen met een privacy officier. John mag deze informatie niet vrijgeven.

4) Wat voor terugkoppeling gebruiken jullie na contact met jongeren?
Er is weinig tijd voor terugkoppeling. Meestal proberen ze zoveel mogelijk dezelfde wijkagent langs te sturen zodat er duidelijkheid is voor de agent en voor de jongeren.

5) Wat weten jullie over de achtergrond van hangjongeren?
Dit verschilt per incident. Afhankelijk van hoe vaak de politie al in aanraking is gekomen met de jongeren. Ze bouwen hun dossier op aan de hand van incidenten en individuele gesprekken met de jongeren. De informatie komt van de wijkagent, jeugdagenten, jeugdwerkers, jeugdcoach van de gemeente en ook van de scholen waar de jongeren op zitten.

6) Gebruiken jullie deze informatie ook als jullie met ze praten?
Als er een incident is heeft de agent geen tijd om informatie over de groep op te zoeken. Een wijkagent probeert wel een positieve relatie met de jongeren op de bouwen door ze buiten incidenten om te bezoeken en een kort vriendelijk gesprek te houden.

7) Hoe open je een gesprek met de jongeren?
John begroet ze vriendelijk "Hoe is het jongens?" Hij houdt het gesprek laagdrempelig. Het is belangrijk om duidelijke afspraken te maken zodat er geen misverstanden ontstaan. Een groepsgesprek werkt vaak niet en daarom liever de leider van de groep alleen spreken. John probeert ze te confronteren met de situatie om ze in te laten zien hoe anderen er over denken.

Voorbeeld: 8 jongeren staan bij de ingang van een winkelcentrum. Ouderen voelen zich bedreigd door de groep jongeren. Wijkagent stapt er op af en vraagt ze. "Kun je je voorstellen dat ze zich zo voelen?"

8) Hoe reageren de jongeren?
Als je als politieagent de jongeren direct beschuldigd reageren ze direct negatief en wordt dit effect versterkt door de groep.

9) Hoe reageer je op bedreigingen?
Direct afkappen en meenemen naar het bureau of naar de ouders voor een persoonlijk gesprek.

10) Hoe lang duurt een gesprek?
Op straat maar meestal maar 5 tot 15 minuten. Als het gesprek niet loopt zal de agent het gesprek afkappen. Persoonlijke gesprekken bij de ouders of op het bureau kunnen wel 2 uur duren. Door langs te gaan bij het jeugdhonk kan de wijkagent contact leggen met de jongeren. Het is effectiever om vaak kort contact te hebben.

11) Zijn er verschillende fases in een gesprek?
Niet echt van toepassing omdat de gesprekken kort gehouden worden. Het lijkt er op dat er wel eerst een kennismaking en daarna een zakelijke afhandeling is.

12) Wat probeer je te bereiken als je op een groep jongeren af stapt?
Vaak is het vooral ze leren kennen. Bij overlast ze wel weg zien te krijgen. Dit is beter te realiseren als er al een band is tussen de agent en de jongeren. Voorbeeld: Schoolterrein waar jongeren 'savonds en 'snachts rondhingen er was veel overlast maar de politie kon er weinig aan doen omdat het openbaar terrein was.

13) Wat heb je te bieden aan oplossingen als jongeren overlast veroozaken?
De jongerenwerker is er om oplossingen te bieden, de politie is niet verantwoordelijk voor de hulpver-

lening. De jongerenwerker kan activiteiten of een hangplek aanbieden. De politie geeft het altijd door aan andere instanties.

Bij het gegeven scenario zou de politie er met twee agenten heen gaan om te kijken wat er gebeurd is en waar mogelijk contact opnemen met de getuige aangezien er anders geen zaak is. De groep wordt mede verantwoordelijk gehouden omdat ze het hebben laten gebeuren. De agent probeert de jongeren uit te leggen hoe anderen er over denken. Door de situatie om te draaien moeten ze een idee krijgen van wat ze hebben gedaan. Als de jongeren elkaar aanwijzen heeft het voor de politie weinig zin om er mee verder te gaan, zonder bewijs kunnen ze niet vervolgen. Doordat de jongeren in een groep zijn wordt hun reactie snel versterkt door groepsgedrag. Als iemand aggresief reageert zal dit versterkt worden door de groep. De politieagent moet kunnen incasseren. Hij kan niet zomaar tegen de jongeren in gaan dat heeft geen zin.

Scenario 1
In dit scenario moet de groep zelf regelen hoe ze de schade vergoeden. Ze mogen onderling bepalen hoe het betaald wordt. Hier wordt dan ook de vraag gesteld: "Waarom hebben jullie het gedaan?" De agent zal duidelijke afspraken maken zodat er geen twijfel bij vervolgincidenten. Deze oplossing en het vertrouwen dat ze het ook doen zal alleen werken bij een milde groep die nog niet in de herhaling gevallen is. Als dit de eerste melding zou zijn, zou het zo kunnen verlopen. John probeert duidelijk te zijn. Geen uitzonderingen maken. Vandaag mag het niet en morgen mag het ook niet. De jongeren moeten als een jonge pup behandeld worden. Simpel en duidelijk blijven is belangrijk. Ook zal hij ze belonen op een later moment door een compliment te geven als hij langs loopt en ze zich wel goed gedragen.

Scenario 2
Het is belangrijk dat de agent laagdrempelig begint. Dat is hier duidelijk niet het geval omdat hij direct ter zake komt. Verder is het belangrijk dat de agent niet over zich heen laat lopen. Een situatie met hangjongeren kan snel escaleren, het gaat ook zeker niet altijd goed. Volgens John is het belangrijk dat de agent rustig blijft en eerst contact maakt. Als iemand in de groep agressief reageert zal al snel de hele groep een aggresieve houding aanmemen. Op het moment dat iemand een wapen trekt is het niet meer terug te draaien. In dit geval zal de agent backup er bij moeten roepen en de persoon met het wapen moeten arresteren.

B Visualization experiment setup

This experiment was implemented as a web-form that the participants could fill in online.

Introduction
In this experiment I ask you to imagine that the virtual agent that is displayed is in a conversation with somebody else. You will be asked to give ratings for twelve screenshots of the virtual agent. Furthermore there are four open questions. The experiment requires about 15 minutes. If you are willing to join the follow-up experiment, please fill in your email address at the end of the experiment. The results will be published anonymously. Thank you for taking the time to participate.

For each of the four conflict strategies, with three images for each conflict strategy. Strategies used: Cooperating, Accommodating, Avoiding, Competitive. See Figure 32.

Rate the posture you see on the following scale:	submissive ◯ ◯ ◯ ◯ ◯ dominant
Rate the posture you see on the following scale:	hostile ◯ ◯ ◯ ◯ ◯ friendly
Do you think the posture fits with [strategy]* behavior?	not at all ◯ ◯ ◯ ◯ ◯ very much

* The name of the strategy was filled in here.

Figure 32: A screenshot of the experiment for the cooperating strategy

Conflict Strategies
Nederlandse antwoorden zijn toegestaan in dit onderdeel.

Describe in key words or a small sentence what cooperating behavior or posture looks like to you.
Describe in key words or a small sentence what accommodating behavior or posture looks like to you.
Describe in key words or a small sentence what avoiding behavior or posture looks like to you.
Describe in key words or a small sentence what competitive behavior or posture looks like to you.

Demographics
Age
Gender
How much experience do you have with virtual characters? None ◯ ◯ ◯ ◯ ◯ Very much
Email Address (optional)
Any comments or suggestions? (optional)

C Strategy selection experiment setup

This experiment was implemented as a web-form that the participants could fill in online. This experiment was completely in Dutch.

Introduction
Dit experiment gaat over de interactie tussen Barry (een jongen die bij een groep hangjongeren hoort) en wijkagent Adrie. Barry en Adrie praten met elkaar in het stadspark. Het experiment duurt ongeveer 15 minuten. Het experiment bestaat uit het beoordelen van afbeeldingen en het is de bedoeling om naar de houding te kijken en niet naar de gezichtsuitdrukking. Eerst is het de bedoeling om drie woorden te selecteren die het beste bij de houding in de afbeelding passen. Dit is nodig voor vier afbeeldingen. Hierna volgen acht korte gesprekken. Elk gesprek speelt zich af met een andere Barry die andere eigenschappen heeft. In deze gesprekken ligt de focus op Barry en hoe hij volgens jou

zou reageren tijdens het gesprek. Elk gesprek bestaat uit zes plaatjes en in elk gesprek zitten twee keuzemomenten. Het is mogelijk met de 'terug' knop een aantal stappen terug te kijken. Als een keuze gemaakt is kan deze alleen niet teruggedraaid worden. Tenslotte zijn er nog enkele algemene vragen.
Notitie: Het is niet mogelijk om tijdens het experiment de 'Terug' knop van de web-browser te gebruiken. Gebruik in plaats daarvan de 'terug' en 'verder' knoppen onderaan de pagina om te navigeren. De resultaten van dit experiment worden anoniem verwerkt.

C.1 Dutch adjectives for conflict strategies

For four images, adjectives that describe the conflict strategies, See Figure 33.

Figure 33: A screenshot of the experiment where the participant selected three adjectives.

C.1.1 Competitive

- Aanvallend
- Autoritair
- Brutaal
- Dominant
- Schaamteloos

C.1.2 Avoiding

- Afhankelijk
- Kortaf
- Verlegen
- Onderdanig
- Gesloten

C.1.3 Cooperating

- Attent
- Behulpzaam
- Spontaan
- Vastbesloten
- Levendig

C.1.4 Accommodating

- Buigzaam
- Nederig
- Meegaand
- Tolerant
- Bescheiden

C.2 Dutch conversations and descriptions personalities and APS

This is followed by the eight conversations described in 7.4. With each image the personality and APS of the juvenile are described using the following sentences.

C.2.1 Personality

- Competitive:
  Hij is een dominant persoon die vaak brutaal reageert en schaamt zich nergens voor.
- Avoiding:
  Hij is een redelijk verlegen persoon die weinig zegt en zich vaak onderdanig opstelt.
- Cooperating:
  Hij is heel spontaan en praat vaak heel levendig en wil meestal wel helpen.
- Accommodating:
  Hij is een bescheiden persoon die veel tolereert en meestal maar mee gaat met de groep.

C.2.2 Active Pursuit Strategy

- Competitive:
  Hij kiest er voor om terug te vechten en wil zijn dominantie laten zien.
- Avoiding:
  Hij kiest er voor om zich af te sluiten en kort te reageren.
- Cooperating:
  Hij kiest er voor om te helpen en probeert vastbesloten en attent over te komen.
- Accommodating:
  Hij kiest er voor om zich nederig op te stellen en zich meegaand te gedragen.

C.3 Believability Questions

Hoe geloofwaardig was Barry?	Niet ◯ ◯ ◯ ◯ ◯ Wel
Wat vond je (on)geloofwaardig aan Barry?	
Hoe geloofwaardig was Adrie? (De wijkagent)	Niet ◯ ◯ ◯ ◯ ◯ Wel
Wat vond je (on)geloofwaardig aan Adrie?	

Demographics

Leeftijd
Geslacht
Hoeveel ervaring heb je met virtuele karakters? Geen ◯ ◯ ◯ ◯ ◯ Heel veel
Commentaar of suggesties? (optioneel)