# AN APPRAISAL BASED MODEL OF AFFECT FOR A NEGOTIATING AGENT

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# An Appraisal Based Model of Affect for a Negotiating Agent

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# Contents

# Chapter 1

# Introduction

## 1.1 Introduction

The Man-Machine Interaction Group positioned at the TU Delft is currently working on an Affective Negotiation Support System [10]. This is a system to enhance the skills of novice negotiators. Part of this learning process is a negotiation with a virtual character. The users of the system encounter the most common negotiation problems in the support system, before they encounter them in a real life negotiation. To enhance the realism of the training, the role of affect in a negotiation needs to be studied. If a model of affect is used in the virtual character, the believability of the character can be increased [75]. Therefore a model needs to be built that generates emotions and moods in the agent based on how the scenario evolves. In this thesis an affective model is proposed that is applicable to the negotiation domain, the domain of the training.

Negotiations are a popular topic in literature about agent based modeling. For an overview of the field see for example [36], [47] or [38]. Negotiations occur a lot in the everyday life of humans and are essential for a good social interaction between humans. Lately it is understood that affect plays an really important role in a negotiation [68]. Therefore it is interesting to see if affective agents are able to negotiate with humans in a believable way. In this chapter (TODO summary about this chapter)

## 1.2 Appraisal Based Model

At the moment, many different computational models of affect exist. In [50] an overview is given of the history of computational models of affect and in the chapter 2 a summary of this overview is given. The largest and most important group of computational models are the appraisal based models, with examples like: OCC [54], EMA [29], WASABI [6] and FLAME [22]. Because the appraisal based group is the largest and most promising, the model proposed in this thesis will be an appraisal based model.

An appraisal based model generates an affective state briefly described in the following steps: first the environment is judged or appraised using appraisal dimensions and goals, after that the appraisal dimensions determine which affective state is generated and the intensity of this state. The affective state then, has an influence on the cognition and behavior of the agent but this step is because of time constrains out of the scope of this thesis. In order to make an appraisal based model the following information is required: which affective states are in the model? Which appraisal dimensions are used and how do they predict the affective state that is generated? And how is an event in the environment related to the appraisal dimensions? All these questions will be explained in more detail in this chapter and will be answered in this thesis. The main research question is:

> Which emotion, moods and appraisal dimensions are required in an appraisal based computational model for a virtual negotiation agent?

### 1.2.1 Influence of Affect on Negotiations

For the virtual agent we need an appraisal model that is applicable to negotiation. There are generic appraisal theories, and there is a lot of experimental evidence on the role of affect in negotiations. However, there is no specific computational model that implements the full range of currently known relevant affects in negotiation. To determine which emotions should be modeled in the agent, the experiments about the role of affect in negotiations are used. A literature study is conducted to identify which emotions and moods have influence on a negotiation and what this influence is. This list serves as a starting point for the model proposed in this thesis.

There are two major distinctions between the influences of emotions and moods. The first influence is on the behavior and cognition of the agent, this is called the intrapersonal effects. The fact that felt anger the competitive behavior of a human increases [12], is an example of an interpersonal effect of an emotion. This effect and many more are described in [15] and [12]. Emotions and moods determine to a large extent if someone takes a collaborative or cooperative stance. Emotions also influence the information processing and how thoroughly one thinks about the choices people make [40].

The other group is about the influence of displayed emotion on the other agent, the interpersonal effects. The display of anger increases the concession making of the opponent for example [71]. The displayed and felt emotions do not have to be the same. An agent can choose to strategically display a certain emotion [53] and [2]. These displayed emotions can have influence on the behavior and cognition of the agent [72], [18], [64] and [1]. Here the effect is dependent on how motivated one is to process the emotional display of the opponent [70]. In chapter 3 the first sub question is answered:

**1** Which emotions and moods have an influence on a negotiation and what is the influence?

### 1.2.2 Appraisal Dimensions

Two types of appraisal dimensions exist: the structural dimensions and the intensity dimensions [54] and [29]. In this thesis we focus on the structural dimensions and in particular those structural dimensions that are needed to elicit the emotions and moods that have an influence on a negotiation. Chapter 4 and 5 are about finding the right structural appraisal dimensions.

In chapter 4 the required appraisal dimensions for a negotiating agent are proposed. Three sources are used to describe the structural appraisal dimensions:

- The negotiation experiments themselves (what factors elicited the emotion in the original negotiation experiments that investigate the influence of that emotion on the negotiation process).
- The OCC appraisal model [54].
- The EMA appraisal model [29].

The negotiation experiments themselves are used to stay as close as possible to the original negotiation settings. However, not in all situation do the negotiation experiments provide enough information about the elicitation of the

emotions. For example: there exist a lot of literature about the elicitation of a general positive state in a human, also called happiness, but few experiments that induce the specific emotion joy in the context of a negotiation. Therefore we use the OCC and EMA models as an alternative source for explaining the emotions. A second reason to use these models is to compare how the emotions and moods are elicited in OCC, EMA and, when available, in the negotiation experiments themselves. We will use this strategy of comparing to make sure the interpretation of the emotions and moods is in the correct way. This can be difficult as the three sources, for example, do not use the same name labels for the emotions and moods. The subquestion answered in chapter 4 is:

**2a** Which appraisal dimensions will be used in the model, follwing the negotiation experiments and the theoratical models OCC and EMA?

The appraisal dimensions as proposed in chapter 4 have a problem in one specific situation. Anger and sadness are predicted to be generated in the same situation, by using the same appraisal dimensions, but have conflicting influences on the behavior and cognition of the agent. In that situation it is not clear, which is the right effect on the agent. In an attempt to distinguish between the elicitation of anger and sadness in chapter 5 the dominance appraisal dimension is used. The hypothesis is that it is more believable for a dominant character to show anger and for a submissive character to show sadness. In an experiment conducted as part of this thesis and described in chapter 5 this hypothesis is tested. The result of this experiment can be used to answer the next subquestion:

**2b** Which appraisal dimensions will be used in the model, following the experiment conducted as part of this thesis?

### 1.2.3 Person Environment Relationship

In [50] appraisal theory is described as:

> In appraisal theory, emotions and moods are argued to arise from patterns of individual judgment concerning the relationship between events and an individual's beliefs, desires and intentions, sometimes referred to as the person-environment relationship (Lazarus 1991 [41]).

To elicit an emotion, the environment has to be appraised by the agent. For this appraising, the appraisal dimensions from chapter 4 and 5 are used. However it is not yet clear how the environment relates to the appraisal dimensions in the model. In chapter 6 a list of goals for the agent is described, which is based on the goals of humans in negotiations [17]. However, the goals are now described more formally and measurable. These goals are used to relate the commonly occurring actions in a negotiation to the appraisal dimensions in the model. This chapter can be used as a pseudo code for implementing the model in a specific programming language, for example GOAL [30]. The actual implementation is out of the scope of this thesis. The sub question answered in chapter 6 is:

**3** How do the appraisal dimensions relate to the negotiation scenario?

In the next chapter a general background on emotion modeling, agents and negotiations is given. This is to be able to fully understand the rest of the thesis. In the third chapter the influences of emotions and moods on negotiations are described and the first research question, about which emotions and moods need to be in the model, is answered. In the fourth chapter the appraisal dimensions that will be used in the model are described. They are taken from the OCC or EMA model or the experiments about the effects of emotions and moods on negotiations. The fifth chapter provides the description of the experiment, which has been conducted to measure the influence of the dominance dimension on the perception of an emotional expression. In the sixth chapter the pseudo code of the model is described to make it easy to implement the model in the future. In the last chapter the conclusion of this thesis is provided.

# Chapter 2

# Background

## 2.1 Introduction

In this chapter a general background on the topics that will be studied in this thesis will be given. This chapter is mainly directed to readers that are not so familiar with emotion modeling, agents, or negotiation. An introduction is given to the concept of agents and computational models of affect in general and the research in which those concepts are used is mentioned. Research about collecting all the emotions and moods that have an effect on a negotiation is presented. After that an overview is given about related research that has as topic the comparing of computational models of affect. In this thesis the OCC and EMA models are compared with eaother and with the elicitation experiments. The last section of this chapter provides some background on other research that has been done on the comparison of different models of affect.

## 2.2 Agents

In this thesis an emotional model of affect is proposed for a virtual agent, but what is an agent exactly? In this section we will try to explain what an agent is and how they are used in other research. We focus on the agent that is used in computational research and mainly in artificial intelligence. A definition is given by Wooldridge and Jennings [76]. According to them an agent has four important aspects:

**autonomy** agents operate without the direct intervention of humans or others, and have some kind of control over their actions and internal state

**social ability** agents interact with other agents (and possibly humans) via some kind of agent-communication language

**reactivity** agents perceive their environment, (which may be the physical world, a user via a graphical user interface, a collection of other agents, the internet, or perhaps all of these combined), and respond in a timely fashion to changes that occur in it

**pro-activeness** agents do not simply act in response to their environment; they are able to exhibit goal-directed behavior by taking the initiative.

Now we will explain in a little more detail the research domains where agents are used.

### 2.2.1 Agents in Virtual Envionments

Virtual environments are mainly used for education and training [57]. The current technology allows the environments to be so realistic that people emerge in them and respond on the environments the same way as they would respond to the real world [57]. Virtual agents are applied to different areas such as training applications [58], health interventions [51], marketing [3] and entertainment [16]. The agents that are used in the virtual environments are designed to behave and to look like they have emotions and feelings.

### 2.2.2 Agents in Multi Agent Systems

When more than one agent is used in a software system one speaks of a Multi Agent System, or MAS. An increasing number of computer systems are being viewed in terms of multiple interacting autonomous agents. This is because the multi-agent paradigm offers a powerful set of metaphors, concepts and techniques for conceptualizing, designing, implementing and verifying complex distributed systems. As a result, applications of agent technology have ranged from electronic trading and distributed business process management to air-traffic and spacecraft control [76].

### 2.2.3 Agents in Negotiation Research; Automated Negotiation

In almost all the research mentioned before in this section, such agents need to interact with other agents or humans in order to fulfill their objectives or improve their performance. When agents and or humans have conflicting goals such an interaction is most of the time a negotiation. Negotiation is a form of interaction in which at least two sides, with potantially conflicting interests and a desire to cooperate, try to come to a mutually acceptable agreement. For an overview of the use of agents in relation to a negotiation see [36], [47] and [38]. Negotiation theory incorporates a broad range of phenomena and makes use of many different approaches (e.g. from AI, Social Psychology and Game Theory). The most important topics of research related to negotiations are the following. The negotiation protocol [59]; the negotiation protocol is the set of rules that defines the negotiation. All the valid actions a side can do are part of the negotiation protocol. The negotiation object is the range of issues on which agreement must be reached. This object is fixed or can be changed during the negotiation. The last topic is the agent decision making model [63], this model described how the agent decides on what to do next in a negotiation. Negotiations are a good research environment to study the behavior of agents. Negotiations have many interactions and are suitable to involve multiple agents and or humans. In this thesis a negotiation is also used to test the proposed model of affect because of those reasons.

## 2.3 Computational Models of Affect

Now that it is clear what an agent is the next step is to look at what a computational model of affect is. At the moment there exist many different models of affect. In this section a short historical overview on those models is given. The different type of models and their relation to each other is explained. Before the overview first the affective terms that are used in those models are explained. The terms will be used throughout this thesis so it is important that there will be no misunderstanding on this point.

### 2.3.1 Definition of Affective terms: Mood, Emotion and Affect

Before a general overview can be given about the research on emotions, moods and affect, it is important to describe in detail what we mean with the words

and what the differences is between them. Unfortunately defining those terms is a complex topic, and agreement on one solid definition does not really exist. For literature on the defenition of emotions see for example [39], [54], [56] and [61]. Is this thesis trying to define what an emotions is, is not part the subject, so here we will just explain what is meant with the emotion-related terms in the rest of this thesis.

There are three important concepts that are closely related to each other, but also differ from each other on some points that need to be understand in order to understant the rest of this thesis. The terms are: affect, emotion and mood. Affect can be described as, taken from [10]:

> Affect (as in affective science) is the common term for everything that has to do with emotion, including both emotions and moods.

Affect is the overall term that includes all different affective states such as emotions and moods. The most important differences between a mood and an emotion, according to [10], is that an emotion is short and intense and goes along with a facial expression. Moods are longer, more mediated and do not have a facial expression associated with them. Another important difference is that emotions have a direct connection to an event or action and moods do not have this connection anymore.

### 2.3.2 Overview of Computational Models of Affect

Now that it is clear what is meant by the different affective terms a short historical overview of the models of affect will be given. This overview is based on the far more elaborate overview provided by [50]. In figure 2.1 a graphical representation of the influences of the computational models is given. Computational models of affect can roughly be divided into three different groups. The appraisal based models, the dimensional models and some smaller other models. In this section those groups will be discussed in more detail.

#### Appraisal Based Models

The appraisal based models are the most important group in relation to this thesis as the model that will be proposed is an appraisal based model. Appraisal theory can be described as [50]:

> In appraisal theory the affective state arises from a number of appraisals of the environment in relation to the beliefs, desires and intentions of the person. The judgment of the environment is formalized using appraisal dimensions [25].

Most research on appraisal theories is about the relationship between the appraisal dimensions and the emotion they elicit. The OCC [54] model is a good example of this, here a three structure is used to decide which emotion is elicted based on some specific variables or appraisal dimensions. The appraisal dimensions that are used to classify which emotions is elicted are caled structural appraisla dimensions, the dimansion that are used to specify the intensity of elicted emotion are called intensity appraisal dimensions.

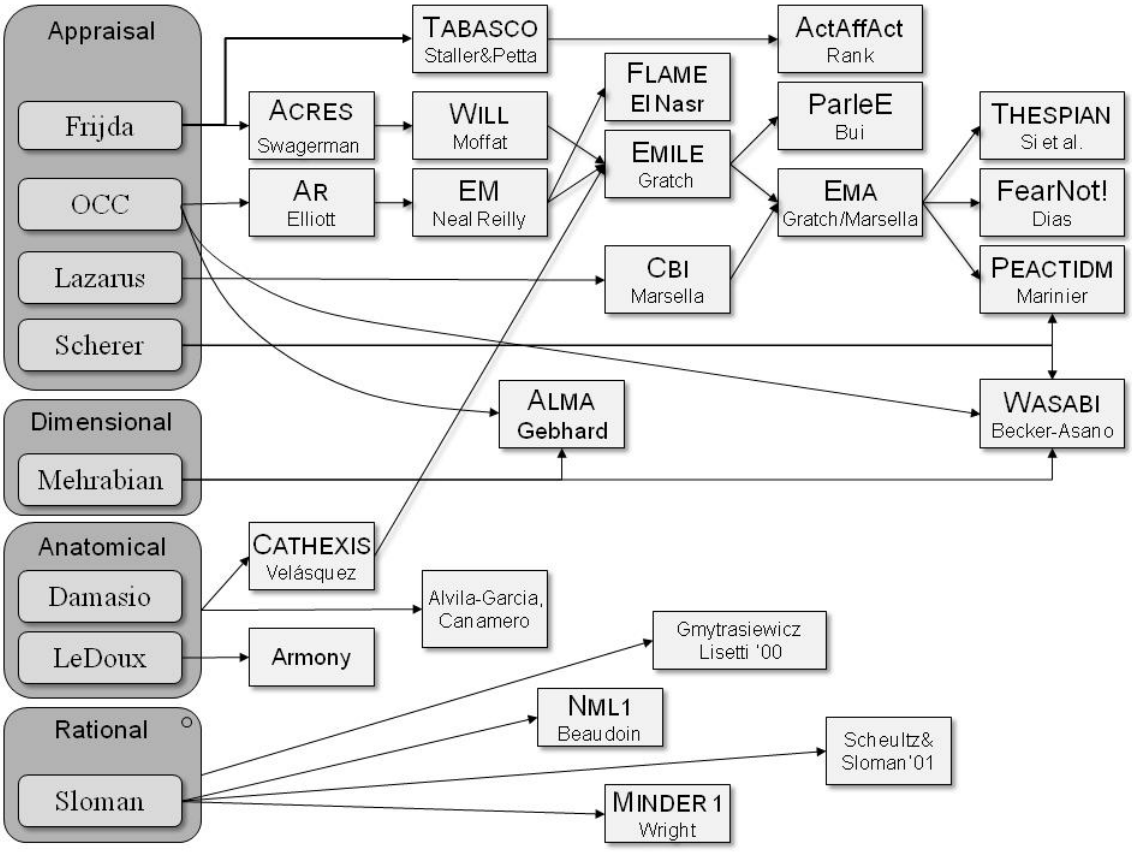


Figure 2.1: A history of computational models of emotion, firgure taken from [50]

In other work [61] on appraisal theory not the structure but the process of an emotion generation is the point of focuss. In that research questions like: 'are the appraisal dimensions working parallel or sequential to each other?' and 'Are the appraisal dimensions working on different levels?' are answered. In this thesis the focus is more on the structure of the appraisal than on the process.

In research about apraisal based models,for example [29], [67] and [22], the modeling of the structure and process of the appraisal is more important than the modeling of the emotions that is generated. Most of the time the emotions is just a name label, sometimes with an intensity. For modeling the resulted emotion a dimensional appraoch is more populair. In the next section it is explained what a dimensional approach is.

### Dimensional Models

As mentioned before, dimensional models are populair to model an affective state itself. The most important dimensional model is the PAD model of Mehrabian and Russell [52]. They model an affective state using three different dimensions: pleasure (a measure of valence), arousal (indicating the level of affective activation) and dominance (a measure of power or control). Some dimensions of the dimensional models are closely related to some of the appraisal dimensions used in appraisal based models. The pleasure dimensions from the PAD model can be mapped to the valence dimension of the EMA or OCC model. It is important however to notice the difference: an appraisal dimensions is a measure that relates the environment to the goals of an individual. Different appraisals can be active at the same time. The dimensions from the dimansional models are summerizing overall states use to model the current affective state for an individual. There can only be one active dimension for each different type, for example, the affective state of an individual has only one value for the plesure of the individual.

The dimensional approach is most of the time used to model the mood of an agent in appraisal based models of affect. This is because an important difference with appraisal based models is that the dimensional models do not contain the relationship with the environment any more. They only contain the different dimensions and the values for each dimension. Since the mood is generally seen as a state that in not related to a specific event the dimensional approach is used to model mood.

### Other Models

The other approaches are not related to the approach used in this thesis, therefore we will only shortly mention them. There are anatomical approaches that use neural circuits [42] to model the generation of emotions. Rational approaches start from the question of what adaptive function does emotion serve and then attempt to abstract this function away from its ïmplementation detailsïn humans and incorporate these functions into a (typically normative) model of intelligence [65]. And there are communicative models that emphasize the difference between the internal state of a human and the visible external affective state [28].

## 2.4 Influence of affect in negotiation

There is a big body of research about the influences of affect on negotiations. Most of the research is about one or a few affective states and their influence on the behavior and cognition of the human in a negotiation. Other research is about the effects on the opponent when showing an emotional state. This specific literature is used in this thesis in chapters 3 and 4, therefore they will not be mentioned here but in those two chapters. Here we will mention only the literature that tries to give an overview of the body of research as well. An example of this is [10], in which the influence of affect on negotiation is reviewed in order to develop a negotiation support system. In [70] the effect of a lot of emotions on negotiations and conflict is reviewed. The focus of this research is on the effect the showing of an emotion has on the other side and a model that predicts those effects is introduced.

## 2.5 Comparing models

To determine the appraisal dimensions that will be used for the final model, a comparison is made between the experiments and the OCC and EMA model. Other literature that compares different models of affect with eachother is [7]. In that paper the EMA model is compared with the CoMERG [8] and the I-$PEFiC^{ADM}$ [33] model. All those models use an appraisal based approach and the focus of the comparison is on the process of encode, compare and respond. This comparison is different from the comparing in this thesis because the emphasis is more on the process and in this thesis it is more on the specific appraisal dimensions and which state they elicit.

Another paper about comparing computational models of affect is the already mentioned paper of [50]. This paper starts with a thorough overview of all the models in the field and their historical meaning. After that those models are divided into different components. This is done because the models can be compared with each other component based. As an example to this they compare the affect intensity component across a few different models. In this thesis essentially the same approach is used, because only one component of the models and experiments is compared with each other. This time it is not the affect intensity component but the affect derivation component. This component relates the appraisal variables with a specific emotions or affective state. The OCC and the EMA model are also mentioned in the paper, but the experiments in which the affect is induced are not. The literature about the experiments is an extra source only used in this thesis.

# Chapter 3

# Influences of Affect on Negotiations

## 3.1 Introduction

In this chapter the effects of emotions and moods in a negotiation that can be found in the literature are described. Only the effects that are related to negotiations are considered. The starting point of this overview is a recent review of the relation between affect and negotiation [10], the influences explained in that paper are extended by findings in other literature. The influences of emotions and moods on the behavior and cognition of the agent are described with as much detail and structure as possible. Next to every effect a reference is given to the research in which the effect is documented.

As mentioned in the previous chapter emotions and moods have different characteristics. Therefore the effects of those two affective states are described separately in this chapter. First the emotions are discussed and after that the moods. The effects of emotions can be divided even further, a difference is made between felt emotions and displayed emotions. What this means is described at the beginning of the displayed emotion section. The effects of displayed emotions are depended on the motivation of the opponent to process the information contained by the emotions.

After the emotion section the effects of the moods are described. Moods are not associated with a facial expression so only felt mood has an influence on the cognition and behavior of the agent.

The result of this chapter is a list of emotions and moods that have an effect in a negotiation. This list determines the scope of the model that will be proposed later in this thesis.

## 3.2 Emotions

In this section all the influences of emotions on negotiations that can be found in the literature is given. A separation is made between intrapersonal and interpersonal effects.

### 3.2.1 Intrapersonal Effects of Emotions

From the paper of Broekens [10] and other literature a list of effects of emotions on negotiations can be made. The next list is a list of all the intrapersonal effects of emotions. By intrapersonal effects we mean effect on the own behavior and cognition. There is a difference in how well each of these emotions has been studied in the literature and there is also a difference in the number of effects that are known for each emotion. Those two things combined suggest that some emotions are more important to negotiations then others. In the following list the first two emotions are the most important to a negotiation, based on the amount of attention given to these emotions in the literature and the number of known influences they have on a negotiation.

- Felt distress increases the competitive behavior of the human. [74]
- Felt anger increases the competitive behavior of the human. [74], [12], [13]
- Felt anger increases the expectation about the material outcome of the negotiation. [45], [44]

- Felt anger increases heuristic thinking. [45]
- Felt anger increases the persuasive power of an angry argument. [19]
- Felt anger increases risk-seeking behavior. [45]
- Felt anger decreases integrative bidding. [1]
- Felt anger increases claiming of value behavior of the human. [1]
- Felt guilt decreases the cooperative behavior of the human. [12], [13]
- Felt regret increases the cooperative behavior of the human, if the initial offer of the person was too high. [78]
- Felt regret increases the competitive behavior of the human, if the initial offer of the person was too low. [77]
- Felt pride-achievement increases competitive behavior of the human. [12], [13]
- Felt pride-achievement increases claiming of value behavior of the human. [12], [13]
- Felt gratitude increases the cooperative behavior of the human. [12], [13]
- Felt gratitude decreases claiming of value behavior of the human. [12], [13]
- Felt fear decreases the expectation about the material outcome of the negotiation. [45], [44]
- Felt fear increases risk-avoidant behavior. [45]

### 3.2.2 Interpersonal Effects of Emotions

Emotions do not only have effect on the own behavior and cognition, but also on the behavior and cognition of the opponent. This effect is called the interpersonal effect. In recent literature [70] it is discussed that this influence is dependent on the motivation to process information from the emotion of the opponent. The height of this motivation changes the influence of a displayed emotion on the other side. When the motivation is high the information from the emotion is processed and when the motivation is low an affective reaction is elicit. Here a list of influences on the motivation to process information from an emotion is given. Next to an effect the reference to the study that describes the effect is given. All the events that are mentioned increase the motivation to process the information.

The human is motivated to process the information of the emotion, if:

**1** The time pressure is low. [71]

**2** The displayed emotion is justified. [74]

**3** Not reaching an agreement has consequences. [69]

**4** The emotional expression is directed at the offer, not the person. [66]

**5** The human has low need for cognitive closure. [71]

**6** The human has low social power. [71], [1]

**7** The human has poor alternatives. [64]

Now the interpersonal effect of emotions can be divided into two situations; when the opponent has high motivation and when the opponent has low motivation.

### Effect of Emotions when Opponents have High Motivation

In this section the effect of displayed emotions on the opponent, who is highly motivated to process the information of the emotions, are given. Here it is assumed that the displayed emotion is perceived as real, not as acted, and is not nessiceraly the same as the felt emotion.

- Displayed joy decreases the concession making of the opponent. [71]
- Displayed joy increases how much the opponent likes you and wants to negotiate again with you. [70]
- Displayed joy increases the expectation of the opponent about the material outcome of the negotiation. [71]
- Displayed anger increases concession making of the opponent. [64], [71]
- Displayed anger decreases how much the opponent likes you and wants to negotiate again with you. [1]
- Displayed anger decreases the expectation of the opponent about the material outcome of the negotiation. [64], [71]
- Displayed guilt decreases the concession making of the opponent. [73]
- Displayed guilt increases how much the opponent likes you and wants to negotiate again with you. [73]
- Displayed guilt increases the expectation of the opponent about the material outcome of the negotiation. [73]
- Displayed regret decreases the concession making of the opponent. [73]
- Displayed regret increases how much the opponent likes you and wants to negotiate again with you. [73]
- Displayed regret decreases the expectation of the opponent about the material outcome of the negotiation. [73]
- Displayed worry increases the concession making of the opponent. [73]
- Displayed worry decreases how much the opponent likes you and wants to negotiate again with you. [73]

- Displayed worry decreases the expectation of the opponent about the material outcome of the negotiation. [73]
- Displayed pride-achievement increases the concession making of the opponent. [13]
- Displayed pride-achievement increases the integrative behavior of the opponent. [13]
- Displayed disappointment increases the concession making of the opponent. [73]
- Displayed disappointment decreases how much the opponent likes you and wants to negotiate again with you. [73]
- Displayed disappointment decreases the expectation of the opponent about the material outcome of the negotiation. [73]

There is a slight difference between the emotions guilt and regret. Guilt has a stronger effect on demands [73]. A possible explanation could be that expressions of regret are more ambiguous. Expressing regret for not having conceded more could indicate regret for hurting someone else or regret for not having been more strategic and self-interested. Expressions of guilt are more unequivocal in that they necessarily imply that one feels bad about one's behavior. This explains the difference in expectations about the negotiation outcome that results from perceiving those two emotions.

**Effect of Emotions when Opponents have Low Motivation**

Now an overview of the effects in the low information processing motivation condition is given. It is possible that some of these effects are already mentioned in the list for high motivated opponents. In that case the effects are the same in the two conditions and the motivation of the opponent is not relevant for this effect.

- Displayed joy influences the mood of the opponent positively. [5], [70]
- Displayed joy increases how much the opponent likes you and wants to negotiate again with you. [14], [70]
- Displayed joy increases happiness of the opponent. [70]
- Displayed distress influences the mood of the opponent negatively. [5], [70]
- Displayed anger influences the mood of the opponent negatively. [5], [70]
- Displayed anger decreases how much the opponent likes you and wants to negotiate again with you. [1], [14], [70]
- Displayed anger increases anger of the opponent. [70]
- Displayed anger increases the chance the opponent deceives you. [69]
- Displayed anger increases the competitive behavior of the opponent. [70]

- Displayed guilt influences the mood of the opponent negatively. [5], [70]
- Displayed regret influences the mood of the opponent negatively. [5], [70]
- Displayed worry influences the mood of the opponent negatively. [5], [70]
- Displayed disappointment influences the mood of the opponent negatively. [5], [70]
- Displayed fear influences the mood of the opponent negatively. [5], [70]

## 3.3 Moods

In the literature it is found that mood also has some important effects on the course of the negotiation. Mood, most of the time, is seen as an average over the recently felt emotions. In the rest of this section positive and negative mood are called happiness and sadness, because that is how they are called most in the experiments. Since a mood does not have a facial expression associated with it, mood only influences the behavior and cognition of the self.

- Felt happiness increases heuristic, big picture and creative thinking. [24]
- Felt happiness increases integrative bidding. [55]
- Felt happiness increases the persuasive power of a positive argument. [10]
- Felt happiness increases the cooperative behavior of the agent. [55]
- Felt happiness increases the expectation about the material outcome of the negotiation. [15]
- Felt happiness increases the value created in the negotiation. [10]
- Felt happiness increases concession making. [4]
- Felt happiness reduces conflicts. [5]
- Felt happiness increases creative thinking. [45]
- Felt sadness increases detailed and critical thinking. [45]
- Felt sadness decreases integrative bidding. [10]
- Felt sadness increases the persuasive power of a sad argument. [19]
- Felt sadness increases the compative behavior of the agent. [74]
- Felt sadness decreases the expectation about the material outcome of the negotiation. [45], [44]

## 3.4 Discussion and Conclusion

After this chapter a list of emotions and moods that have influence on a negotiation can be given: the ten emotions joy, distress, anger, guilt, regret, worry, pride-achievement, gratitude, disappointment and fear and the two moods happiness and sadness have influence on negotiations in some way. If the agent is able to model all those affective states and their effects, it is assumed that the agent behaves in a believable way.

One remarkable observation that can be made right now is that the model so far contains only one different positive emotion (joy) and a lot of different negative emotions (all the others). This is not strange because this observation can be made in most of the models of emotions up until now. Both Ekman [21] and EMA [29] use more negative than positive emotions for example. OCC [54] is an important exception to this because it has exactly the same amount of positive and negative emotions. This can be explained because negative emotions are more noticeable than positive ones since attending to negative events is more important for our survival than attending to positive events. There are considerably more ways to describe negative emotional experiences than there are for positive ones. In the field of research about negotiation the focus is more on specific negative emotion and their effects than it is on specific positive emotions. There are very few studies know to the author that focuses specifically on the effects on negotiations of, for example, enthusiasm, pride or gratitude.

# Chapter 4

# Appraisal Based Model for a Negotiating Agent

## 4.1 Introduction

In the chapter on the consequences of affect on negotiation, we investigated which emotions and moods play a major role in influencing the negotiation behavior of people. This investigation identified ten emotions (joy, distress, anger, guilt, regret, worry, pride-achievement, gratitude, disappointment and fear) and two moods (happiness and sadness). In the current document we investigate how these emotions get elicited. We take an appraisal based approach to emotion elicitation. Such an approach is characterized by relating appraisal dimensions (processes that evaluate a situation) to emotions. Two types of appraisal dimensions exist: the structural dimensions and the intensity dimensions [54] and [29]. Here we focus on the structural dimensions and in particular those structural dimensions that are needed to explain the elicitation of the ten emotions and two moods that play a major role during a negotiation. Our discussion of the appraisal dimensions will thus be limited by this set of emotions and moods.

We use three sources to explain the factors that elicit these negotiation-relevant emotions:

- The negotiation experiments themselves (what factors elicited the emotion in the original negotiation experiments that investigate the influence of that emotion on the negotiation process).
- The OCC appraisal model [54].
- The EMA appraisal model [29].

Our main goal is to stay as close as possible to the original negotiation settings, because if an intelligent emotional negotiation agent has to simulate the emotion and its effect on the negotiation process, then staying close to the original factors that elicited the emotion will be our best guarantee to elicit the emotion at the right time in the right situation. However, the experiments do not provide enough information to explain the elicitation of all the emotions. Therefore we use the OCC and EMA models as an alternative source for explaining the emotions. A second reason to use these models is to compare for all ten emotions and two moods, how these are elicited in OCC, EMA and, when available, in the negotiation experiments themselves. We have used this strategy of comparing to make sure we interpreted the emotions and moods in the correct way. This can be difficult as the three sources, for example, do not use the same name labels for the emotions and moods. Therefore we focus, again, on the structural appraisal dimensions and compare across these models how each emotion can be explained. We feel this gives a solid grounding to determine the actual emotions the negotiation experiments are referring to.

Our appraisal-based analysis and comparison results in a negotiation-specific structural appraisal model, by which we mean a model that lists the necessary appraisal dimensions and their relations to the ten emotions and two moods identified earlier. In this model we propose, in addition to the appraisal dimensions that could be identified based on the three sources, one other appraisal dimension: dominance. We argue that this dimension is needed to discriminate between anger and sadness.

This chapter is structured as follows. Before the actual comparing an overview is given of the used appraisal dimensions in OCC and EMA. This way it is clear

what is meant when a reference is made to those dimensions. Than we compare how the ten emotions and two moods are elicited according to the negotiation studies and the theoretical models OCC and EMA. After that some general comparisons are made between those three sources. Finally, we present the structural appraisal model.

## 4.2 Appraisal Dimensions used in the Theoretic Models

In order to understand the comparison that will be made in this chapter, between the theoretical appraisal models and the literature about experiments in which an affective state is induced in a human, it is important to know which structural appraisal dimensions are used by the theoretical models. This section provides a short overview on the dimensions used by OCC and EMA to determine which affective state will be generated. The intensity appraisal dimensions are not considered because they are not used in this thesis, they can however be found in appendix B. In figure 4.1 the OCC model is presented graphically.

### 4.2.1 Structural Appraisal Dimensions in OCC

**Desirability** evaluates the consequence of an event with respect to the goals of the person.

**Desirability-for-other** Here a person estimates how desirable an event is for the other person. This can be done by thinking that the other person has the same goals as the judging person. But this can result to wrong judgments. Another way is by making a model of the other and judge the desirability of an event for the other by this model.

**Praiseworthiness** evaluates the action of somebody with respect to the standards of the person.

**Appealingness** evaluates an aspect of an object with respect to the attitudes of the person.

**Agency** evaluates which side is responsible for the action; in the OCC model this dimension can have two values; self or other.

**Likelihood** Likelihood determines how certain it is that an event is going to happen or if the event has already happened. It separates the prospective emotions from the actual.

**Prospect Relevance** determines if an event was previously occosiated with a prospect.

### 4.2.2 Structural Appraisal Dimensions in EMA

**Perspective** Although not really an appraisal variable it is important to note that each person evaluates his environment from his own perspective. A person can imagine how the situation would look from another person's perspective, this is especially important for the generation of social emotions such as guilt or shame

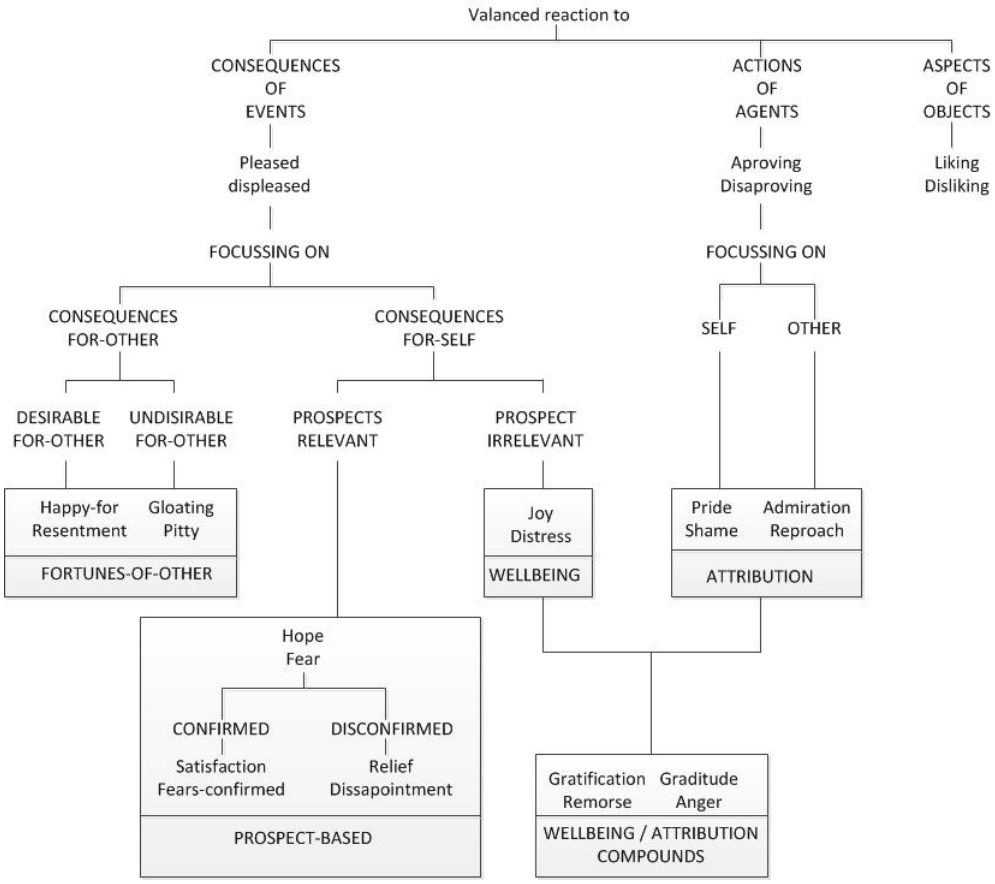


Figure 4.1: The OCC model, figure is a simplification of the figure in [54]

**Desirability** An event is considered as desirable if it facilitates a state to which the agent attributes positive utility or if it inhibits a state with negative utility. Desirability's divides the positive from the negative emotions.

**Causal attribution** The causal attribution determines if a person deserves credit or blame for his actions. The following questions are important to determine if the person deserves blame or credit: Who caused the outcome? Did they foresee the consequence? Was it intended? Where they coerced?

**Likelihood** Likelihood determines how certain it is that an event is going to happen or if the event has already happened. It separates joy from hope and distress from fear.

## 4.3 Affect Specific Comparison

In this section the appraisal dimensions of the experiments, the OCC model and the EMA modal are compared. This is done for every emotions and mood that has an influence on negotiation according to the previous chapter. In this section the emotion joy and the mood happiness are combined, the same goes for the emotions distress and the mood sadness. This is done because based on the appraisal dimensions there is no difference in the eliciting of the mood or the emotion. We will come back to this in the discussion. The emotions guilt and regret are also taken together because in the experiments and in the OCC model the appraisal dimensions used to elicit the emotions are the same. Only the EMA model makes a small distinction which will be explained in the section about guilt and regret.

### 4.3.1 Happiness and Joy

Happiness is induced in experiments in several ways. In [55] happiness is induced by showing the participators cartoons and giving them a gift before the experiment. The method of giving somebody a gift to generate a positive affective state is done more often in the literature (for examples, see: [15], [34] and [35]). Another study of happiness is [4]. In this study, the affect is induced by making people smell pleasant scents before the negotiation and by spraying those scents in the room where the negotiation takes place. A common factor in all these experiments is that the affect is induced before the negotiation and the influence of the affect is measured during the negotiation.

From these experiments one can conclude how happiness is generated in a human. A positively valenced consequence of an event, for example the funny cartoons, or a positive valenced action, for example receiving a gift, or a positively valenced attribute, for example a specific smell, is required. The happiness generated in this way is longer lasting and has effects in a negotiation conducted afterwards.

The positive affective state that is induced in the experiments, happiness, is not predicted by the OCC model. This is probably because the OCC model focuses on the generation of emotions. Joy is a more common name for a short positive affective state and happiness is a more common name for a longer lasting positive affective state. Joy is in the OCC model the result from positively

valenced consequences of an event. This is different from the dimensions that are used in the experiments to generate happiness. Happiness in the experiments is generated by positively valenced consequences of events but also by a positively valenced action of an agent and a positively valenced attribute of an object. The distinction between those groups is not made in the experiments. Therefore joy and happiness are indeed closely related, one can say that joy is a specific form of happiness, the form in which the consequences of events are considered. Happiness in the experiments is more general than the joy in the OCC model.

Joy in EMA is an emotional state. Every emotional state in EMA has a mood state associated with it, which has no name label. The emotional state joy and the nameless mood associated with it in EMA have exactly the same appraisal dimensions as the happiness generated in the experiments.

Valance about events that have happened is the crucial appraisal variable for the generation of happiness and joy. So the model of emotions that is going to be used in the agent need to have an appraisal dimension that determines if an event has actually happened and if the event is perceived as positively valenced for the agent.

### 4.3.2 Sadness and Distress

Another affective state that is induced in experiments is sadness. In a study by [19] the sadness is induced by reading a sad story. After that a negotiation task is conducted and the effects are measured. The story had nothing to do with the negotiation. In [37] the method of reading a story to induce sadness is used as well. This time the effects are even increased by telling the participants that they have to try to imagining the story as vividly as possible. The subjects of the stories are negatively valenced by the reader of the story. For example, the death of the readers' mother is a subject in one of the stories. Negatively valenced events, actions or attributes result in sadness by the respondent.

Sadness is not predicted by the OCC model. This probably has the same reason as why happiness is not predicted, sadness is a more common name for a mood state than for an emotion and OCC does not contain moods. Distress is in the OCC model the result from negatively valenced consequences of an event. This is different from the dimensions that are used in the experiments to generate sadness. Sadness in the experiments is generated by negatively valenced consequences of events but also by a negatively valenced action of a agent and a negatively valenced attribute of an object. The distinction between those groups is not made in the experiments. Therefore distress and sadness are closely related, one can say that distress is a specific form of sadness, the form in which the consequences of events are considered. Sadness in the experiments is more general than the distress in the OCC model.

Distress in EMA is an emotional state which has a nameless mood associated with it. The emotional state distress in EMA and sadness in the experiments use the same appraisal dimensions.

Sadness requires the same appraisal dimensions as happiness. he only difference is that the valence about an event must be negative instead of positive.

### 4.3.3 Anger

In [44] anger is not really induced but the disposition to feel anger is measured by a questionnaire. The disposition to feel anger is more a personality trait than the actual experience of anger. In [74], the researchers use questionnaires to relate the actual angry level of a person with the risk-seeking behavior and the expectations of the material outcome of a negotiation. The anger in this research is not induced so the anger must be a longer lasting emotional state about something that happened before the experiment.

There are also studies where the anger is induced on purpose before the negotiation. In [12] and [13], for example, the anger is induced by the feedback that is given on a negotiation task. The feedback is that the previous negotiation failed for both the subject and the opponent because of the behavior of the opponent. This way the subject gets angry at the opponent. After the feedback the actual negotiation is conducted in which the effects of the anger are measured. In the study, the anger is a result of feedback on a negotiation and not the result from an event in the negotiation self. In another article by [1], anger or compassion is induced by an event in a negotiation in which both sides are biased to belief in a certain way about the negotiation. Both sides believe that the behavior of the opponent is inappropriate according to a norm that is told to the subjects before the experiment. After this biased negotiation a normal one is conducted. The cause of the anger in both researches is a negative event for the person as a result of behavior of the opponent.

The anger induces in the experiments above is always a longer lasting emotional state, because the anger is always measured in another negotiation than in which the anger is induced. The anger in the experiments is always directed at the opponent and that opponent is believed to be the cause of the anger. The affective state of anger is thus always related to a specific person that is the cause of the anger.

Anger in the OCC model results from a negatively valenced consequence (distress) of an action of the opponent. The anger in the OCC model thus uses the same appraisal dimension as the anger induced in the experiments. Therefore we assume that the same affective state is considered and not only the same name label.

In EMA anger is an undesirable event that is intentionally caused by another agent. EMA uses the same appraisal dimension as the anger in the experiments and it is thus considered to be the same affective state.

The appraisal dimensions that are important are agency, determines who is responsible for an event and thus who is the target of the anger, and valence, the event must be perceived as negative for the self.

### 4.3.4 Guilt and Regret

Like in the anger experiment described, in [13] and [12] guilt is induced by the feedback that is given on a negotiation task. The performance feedback consisted of information that was designed to elicit one of the four experimental conditions: success due to self, success due to counterpart, failure due to self, and failure due to counterpart. In all four performance feedback conditions, the importance of the success or the failure and the personal responsibility of the self or the counterpart were emphasized to elicit clear cognitive appraisal of the

situation. Guilt gets elicited in the failure due to self condition. Unfortunately from the experiments it is not clear if this failure has a negative valence to the other side or not.

A study about regret is [77]. In that study the regret is induced by telling the practitioner that he could do better after a session of the ultimate game. This game is about dividing ten coins between two persons. One of the persons has the possibility to propose a division, for example eight for himself and two for the opponent. The other person has the possibility to either reject this or accept this offer. In the experiment the researchers tell the subject after one round that he could have earned a lot more from the ultimate game and that he himself is the cause for not claiming enough. This negative outcome for the practitioner that is caused by him results in the feeling of regret. After the induction of regret another round of the ultimate game is played and the effect of the regret on this round is measured. The induction is thus done in a different round than the measuring of effects. This means that the guilt and regret studied in the experiments are longer lasting emotional states.

Regret is also generated in an experiment reviewed by [78]. The participants of the experiment read a story about one out of two dissatisfying conditions about the service of a service provider. After the reading of the story the emotional state of the participants is measured. In the first dissatisfying condition the participants believe that they have chosen the wrong service provider. This is a negatively valenced event caused by the person itself which results, in accordance with the other experiments described before, in regret.

In the OCC model both regret and guilt are not described. The appraisal dimensions that are used in the experiments to induce guilt are: the person self is the cause of the event, the event has a negative valence for the self and the event must have a negative valence for the opponent. When those dimensions are used in the OCC model, the model predicts that the following emotions will be generated: pity, shame and remorse. Here it depends if the focus is more on the action or on the consequence of the action. When the focus is more on the action shame is generated strongly and when the focus is more on the consequence remorse is generated more strongly. The appraisal dimensions that are used in the experiments to induce regret are: the person self is the cause of the event, the event has a negative valence for the self and the event must have a positive valence for the opponent. When those dimensions are used in the OCC model, the model predicts that the following emotions will be generated: resentment, shame and remorse. Here it depends if the focus is more on the action or on the consequence of the action. When the focus is more on the action shame is generated strongly and when the focus is more on the consequence remorse is generated more strongly. Here the results from the experiments and the OCC model do not correspond to each other.

The EMA model does not make a distinction between the emotions guilt and regret. They only describe guilt and it arises when an agent is deemed blameworthy for causing an outcome that some other agent is believe to find undesirable. In the experiments guilt can only arise when the event is perceived as negatively for the self. EMA also generates guilt in those situations but also generates guilt in the special situation where the event is positive for the self but negative for the other. This special situation is not covered in the experiments.

The emotion guilt is generated when an event is valenced negatively by both the self and the opponent. The person that caused the event will feel guilty

about this. Regret is generated when an event is negatively valenced for the self and is caused by the self. The valance for the other person does not matter for the generation of regret.

### 4.3.5 Worry

In the literature there exists one experiment [73] that mentions the intrapersonal effect of worry. In this experiment the emotion is not induced in a human but only made visible by an agent. This provides no information about the required appraisal dimensions for the elicitation of worry. In the OCC and the EMA model no emotion has the name label worry. This all results in the conclusion that there is not enough information on the emotions worry available. Therefore this emotion will not be modeled in this thesis.

### 4.3.6 Pride Achievement and Gratitude

In [13] and [12] the pride-achievement emotion is induces by giving feedback on a previous negotiation. The feedback tells the negotiator that the previous negotiation was a success and that this was the result of the behavior of the self. Unfortunately it is not clear from the experiments if the success or failure of the first negotiation is positive or negative for the opponent.

In the same research the gratitude emotion is also induced. The difference is that the gratitude emotion is elicited when the negotiator is told that the negotiation succeeded because of the opponent.

In the OCC model both pride-achievement and gratitude are described. Pride-achievement is called pride and not pride-achievement as the experiments call it. But it is expected that there is no difference between those two name labels. In both the experiment and the model pride is generated after a positive event caused by the self. When an event is judged as positive and is caused by the other side the model predicts the generation of admiration. This is different from the experiments in which gratitude is generated in this situation. Gratitude is described in the OCC model as admiration about the action of the other side and joy about the related consequences.

The differences between the model and the experiments can be explained because the model has an extra appraisal dimension. The extra dimension is the question if the related consequences of an action should be considered or not. This dimension differentiates pride from gratification and admiration from gratitude. Pride and admiration are generated when only the action is judged; gratification and gratitude are generated when the consequences of the event are also considered. In the experiments this distinction is not made, it is not clear if a person judges an event only on the approving of the action or if the person also considers the consequences.

There is another difference between the experiments and the OCC model. Pride, gratification, admiration and gratitude are all generated in the OCC model independent from the valence for other dimension. In the experiments it is not very clear if the valence for other dimension is important, but is seems as if the valence for other is positive as well. They speak about a success of the negotiation and not about a partial success.

The pride and gratitude emotions are not discussed in the EMA model.

Agency and valence are required appraisal dimensions. The emotions are a result from an event that is positively valenced for the self. If the event is caused by the self Pride achievement is elicited and if the event is caused by the opponent gratitude is elicited.

### 4.3.7 Fear

There is one experiment known about fear in relationship to a negotiation. In [44] the disposition to feel fear is measured by a questionnaire. The disposition to feel fear is more a personality trait than the actual experience of fear. In another questionnaire the expectations about the future are measured. A disposition to feel fear is positively correlated with a negative view about the future. This experiment does not provide enough information about the generation of fear so the appraisal theories are consulted.

In OCC fear is a result from a negative valenced event that is perceived to be happening in the future. Fear can only be the result of an expected consequence and not of an expected action or attribute.

Fear in EMA results from an undesirable event that did not happen yet, but does have a probability of happening in the future. The EMA definition of fear can be compared with the definition of fear in the OCC model. In both models fear results from a negatively valenced event that is believed to happen in the future.

### 4.3.8 Disappointment

Disappointment is generated in an experiment reviewed by [78]. This experiment is described before in this chapter. The practitioners read a story about a dissatisfying condition. The first condition resulted in regret. The second condition, in which the service of the service provider is less than expected, results in the feeling of disappointment. Disappointment is the result of disconfirmation of the expectations about a positive event in the future [70].

According to the OCC model disappointment results from distress about disconfirmation of positively valenced expectations, which is practically the same meaning as in the experiments conducted in [78]. Here OCC corresponds well with the experiments.

Disappointment or any related emotion is not discussed in the EMA model.

The appraisal dimensions that are required for the emotion disappointment are now described. Disappointment is the result of disconfirmation of the expectations about a positive event in the future [25]. The event in the future is positive so the valence dimension is required to be able to judge the event as positive. The feeling of disappointment is about something in the future. To describe an event as something in the future the likelihood dimension is required. When an event has likelihood less than one, the event did not jet happen and thus must be an event in that is likely to happen in the future. The likelihood dimension can also be used to model the disconfirmation of an expectation. When an event is expected the likelihood of the event is high. If the likelihood of that event suddenly decreases it is not expected anymore. The disconfirmation of an expectation is a sharp decrease in the likelihood of an event. Although disappointment is a result of a future event, the likelihood decrease can be the

result of an actual event. Disappointment can thus be generated because of an actual event.

## 4.4 General comparison

In this section some general differences between the models and the experiments will be discussed.

### 4.4.1 Experiment

Some general remarks about the research of emotions in negotiation can be made after the previous description for each emotion separately. The first notion is that the emotional state is assumed not to change during the experiment. The experiments try to induce one emotional state as strongly as possible in the subject and do not try to change this during the negotiation. The effects that are measured are the effects of that specific emotional state. In negotiations it seems more likely that the emotional state of a negotiator changes a lot during the negotiation. Positive and negative events can directly follow on each other and the side that is responsible for an action is also constantly changing. These dynamic features of emotions in a negotiation are not studied in the experiments.

Another remark is the difference between emotions and moods. The difference between an emotions and a mood is not so clear in the experiments discussed in this chapter. Most of the times they claim to measure the effects of an emotion on a negotiation, but in fact they measure the effect of a longer lasting emotional state which is probably closer to a mood than an emotion. The induction is done before the negotiation in which the effect of the emotional state is measured. Anger for example has a longer lasting effect and the connection between the event and the emotion remains clear even a longer time after the induction [1], [12] and [13]. Sadness has mood aspects, it is also a longer lasting emotion, but can be associated with a sad facial expression. It is out of the scope of this chapter to discuss the difference between an emotion and a mood and to classify the emotional state induced in the experiments as either one of them. For this thesis it is sufficient to relate appraisal dimensions to an emotional state (either an emotion or a mood) with a specific duration, a facial expression or not and a connection to a specific event or not. That emotional state can be related to an effect on the negotiations, which is done in the previous chapter.

### 4.4.2 The OCC Model

When comparing the emotions generated in the experiments and the emotions predicted by the OCC model under the same circumstances, some observations can be made. The first thing that is noticed is that the OCC model generates a lot of different emotions in a situation compared to the experiments. The first reason is that the OCC model divides emotional reactions into tree big groups: reactions to consequences, actions and attributes. In the experiments this distinction is not made. Because it is not always clear which of those emotions have the same meaning as the emotions that have an influence on the negotiation, all the emotions elected to one of the tree groups are taken together

in the final model. An example to clarify this: according to OCC happy-for is a reaction to a consequence, pride is a reaction to an action and gratification is a reaction to a consequence related to an action. Since the experiments do not make this distinction all three emotions are considered in the appropriate case, the case in which the experiments predict happiness, based on the other appraisal dimensions. An exception to this is when there is no clear agent to attribute an event to. In that situation the none option is used for the causal attribution variable and all the emotions that are generated that require a causal attribution are ignored. For example when a positive event for both sides does not have a clear side that caused the event, the event only generates joy and happy-for. No action related emotions are generated.

The second reason for the difference in the numbers of emotions, generated by the OCC model and the experiments, has its origin in the reading of the OCC model. The theory does not describe which emotions are elicited when you move down the tree. If you are pleased about a consequence of something, that has actually happened, you feel joy. If, in the same time, this consequence is presumed to be desirable for the other person you feel happy-for. But it is not clear if you can feel one of those emotions or both of them. To be sure all the possible emotions that can be generated are presented in the final model.

### 4.4.3 The EMA Model

An important difference between EMA and OCC is that EMA contains a mood state. This mood state is the aggregation of the intensities of the recently experienced emotions. The mood state changes more slowly than the emotional states and does not contain a clear connection between the event and the feeling. Every emotion in EMA has a mood associated with it. For example: when experiencing the emotion anger a lot, the angry mood increases. The mood is used to change the intensity of felt emotions and in this way can bias the experience of the agent. The mood states are not given a name label in EMA.

## 4.5 Result

Now the complete model that will be used in the agent can be displayed. In figure 4.2 the appraisal dimensions that are used in the experiments and the appraisal dimension that is introduces in the previous section is displayed. Based on these dimensions the emotions that are generated according to the different sources are shown. The emotions that are not used in the final model are grayed out. When a pair of emotions is red this means that the effects of those emotions are different while the appraisal dimensions used to elicit the emotions are the same. In the discussion this problem will be explained further.

The emotions that do not have a likelihood of one, disappointment and fear, are not displayed in the figure because it would become too big and unreadable. Disappointment is generated when the likelihood of a positive event for the self, decreases sharply. Fear is a reaction to a negatively valenced event for the self that has likelihood between one and zero.

| VS | VO | CA | This thesis | Experiment | OCC | EMA |
|---|---|---|---|---|---|---|
| pos | pos | self | joy + happiness + pride | happiness + pride-achievement | joy + *happy-for* + pride + *gratification* | joy |
| pos | pos | other | joy + happiness + gratitude | happiness + gratitude | joy + *happy-for* + *admiration* + gratitude | joy |
| pos | pos | none | joy + happiness | happiness | joy + *happy-for* | joy |
| pos | neg | self | joy + happiness | happiness | joy + *gloating* + pride + *gratification* | joy + *guilt* |
| pos | neg | other | joy + happiness | happiness | joy + *gloating* + *admiration* + *gratitude* | joy |
| pos | neg | none | joy + happiness | happiness | joy + *gloating* | joy |
| neg | pos | self | distress + sadness + regret | sadness + regret | distress + *resentment* + *shame* + *remorse* | distress |
| neg | pos | other | distress + sadness + anger | sadness + anger | *reproach* + anger | distress + anger |
| neg | pos | none | distress + sadness | sadness | distress + *resentment* | distress |
| neg | neg | self | distress + sadness + regret + guilt | sadness + regret + guilt | distress + *pity* + *shame* + *remorse* | distress + guilt |
| neg | neg | other | distress + sadness + anger | sadness + anger | *reproach* + anger | distress + anger |
| neg | neg | none | distress + sadness | sadness | distress + *pity* | distress |

Figure 4.2: VA: Valence for Self, VO: Valence for Other, CA: Casual Attribution. Appraisal dimensions required according to this chapter and emotions generated according to this thesis, experiments, the OCC model and the EMA model.

## 4.6 Mixed Affective States

When the appraisal dimensions are used, that are described in the experiments, in some cases there are two or more different emotions predicted. This becomes problematic when the effects of those emotions on a negotiation are contradictory. In that situation it is not clear which emotion is more important and thus what the effect is of the emotional state on the negotiation and the behavior of the agent. Below are some situations described and a solution is proposed to determine the most important emotion.

### 4.6.1 Anger and Sadness

Sadness and anger have opposite effects according to the affect derivation model and according to [45]. Sadness decreases the expectations about the material outcome of the negotiation while anger increases these expectations. Sadness increases detailed and critical thinking while anger increases the heuristic way of thinking. The last controversy is that sadness decreases integrative bidding while anger increases this way of bidding. Because of all those differences it is required to make a further distinction between the generation of the emotions anger and sadness, a distinction that is not made in the experiments or in the two models of emotions.

According to [45] a general negative emotion (sadness) and the specific negative emotion anger differ from each other because:

> For example, angry decision-makers experience negative affect about past events yet they also hold optimistic expectations when it comes to predicting the likelihood that they will succeed in a variety of life domains in the future (Fischhoff et al., 2005 [23]; Lerner et al., 2003 [43]; Lerner and Keltner, 2000 [44], 2001). This optimism derives primarily from a sense of certainty and predictability as well as from a sense that individuals have control over life outcomes (Lerner and Keltner, 2001) and-importantly-influences reflections about the future.

The most important difference is that angry people believe that they have control over the situation. This 'control' variable can be found in more literature as a difference between anger and sadness. Probably the most important work that uses control to divide between the two emotions is the PAD scale described in [52]. In this paper they use dominance to divide among emotional states. But the dominance is defined as follows:

> Dominance was defined as a feeling of control and influence over one's surroundings and others ... (e.g. anger ...)

The control from [45] and the dominance from [52] have essentially the same meaning.

In [49] and [60] they define the variables control and power of all kinds of different emotions. Both power and control are high for cold and hot anger and very low for sadness. In [6] nine emotions are mapped to the pleasure arousal dominance space. Anger is mapped to having a high dominance value and sadness and depressed have a very low dominance value. Another paper [27] maps all the emotions that are described in the OCC model to the PAD

space. Again is anger viewed as a high dominance emotion and the more general negative emotion distress has a low dominance value. In [13] and [12] anger is strongly related to dominant negotiation behavior. The other emotions in this research, pride, gratitude and guilt, are not related to dominant negotiation behavior. The EMA model contains the appraisal dimensions controllability and changeability. These two are closely related to the dominance dimension described before. The dimensions do not have influence on the emotion that is generated, they only influences the choice of a coping strategy.

All the above literature provides enough evidence that anger and sadness clearly differ on the dominance variable. Therefore we propose to use this variable as an extra appraisal dimension. In the next chapter this appraisal dimensions will be validated in an experiment with a human.

### 4.6.2 Happiness and Pride

Happiness and pride are generated under the same circumstances. In [13] and [12] the effect of pride on the negotiation is described as increasing the competitive behavior of the person who is experiencing the pride. This effect is the opposite from the effects of happiness that are described in different research, like [24], [55] and [15], where a cooperative behavior is predicted when the person is feeling happy. It is not clear how this can be solved.

## 4.7 Conclusion

In this chapter a model is proposed that contains almost all the emotions and moods that have an influence on a negotiation. Only the emotion worry is not included because there is to less information on the elicitation of worry in the experiments. For every emotion and mood the appraisal dimensions are described. The dimensions are chosen based on how the emotions are elicited in the experiments or, if that source does not provide enough information, the OCC and EMA models are consulted. Some of the affective states have conflicting effects with each other. This could partly be solved by introducing a new appraisal dimensions which will be researched in more detail in the next chapter.

**Valance for Self** The valence of an event is based on how 'good' an event is for the negotiation satisfaction of the agent since negotiation satisfaction is the highest goal the agent wants to achieve (see the affect consequent model). For simplicity the negotiation satisfaction is divided into two sub goals and not three. The two goals are material outcome of the negotiation and relationship with the opponent. The sub goal: feelings about the self, which is described in the affect consequent model, is not used at this point. The agent has a personality which determines how important the material outcome and the relationship with the opponent are compared to each other. Some agents are very focused on the relationship and others are more focused on the material outcome of the negotiation. This also depends on some negotiation parameters. When the negotiation is a one-time meeting between the two sides, material outcome is more important. When it is clear that the sides will meet again after the negotiation it is

more important to maintain a good relationship. When negotiating with a close relative the relationship is more important than when negotiating with a complete stranger. The valance is determined by the influence of an event on the material outcome and relationship and the importance the agent give to those two parameters.

**Valance for Other** The valance for the other is calculated in the same way as the valance for the self with the exception that the real influence and the real importance is not know by the agent. The agent cannot know exactly what the influence of an event is on the material outcome of the opponent because the agent does not know the payoff matrix of the opponent during the negotiation. The agent does not now either the relative importance of the material outcome and the relationship, judged by the opponent. The agent can only guess those values. To guess the values the agent has a model of the opponent, which is initiated before the negotiation and does not change during the negotiation.

**Casual Attribution** The casual attribution of an event is simply the side which initiates the event. We assume that in the scenario nobody is coerced to do something.

**Dominance** For simplicity reasons the dominance relation is described in the private preparation phase of the negotiation and is not changed during the negotiation. The dominance relation depends on the role the agent has in the scenario, naturally the employer has more power because he can decide to hire the employee. The dominance also depends on the alternatives of both sides. When the employer has many other employees looking for the job he has more dominance. When the employee has many other options to work for he has more dominance.

**Likelihood** The likelihood of an event is the probability that the event will happen in the future perceived from one side in the negotiation. This appraisal dimension is the most complex one because it judges all the possible future events instead of only the event that just happened. To reduce the complexity of calculating the likelihood of all the future events, the likelihood is only calculated for the events that are possible in the next turn of the opponent. The number of possibilities is most of the time below five so this greatly reduces the complexity. Only when in the bidding phase the number increases because all the possible offers are options. We will explain later how this problem is treated.

# Chapter 5

# The Influence of Dominance on the Believability of the Agent

## 5.1 Introduction

In the previous chapter it was mentioned that the generation of anger and sadness in the same situation can let to conflicting influences on the behavior or cognition of the agent. A solution was also proposed by making use of the dominance dimension. Before this dimension is going to be used in the model proposed by this thesis we first want to validate the effect of this dimension on the user. One of the reasons to use a model of affect in a virtual agent is to increase the believability and thus enhance human-computer interaction with an agent [75]. In this experiment we want to know which of the two emotions is perceived as more believable by a human and what this believability depends on. To achieve this we conduct an experiment where the role (boss/candidate) of the agent differs and the expression (anger/sad).

We test our hypothesis with a scenario in which the user does something that is negative for the goals of the agent, a situation that would predict both anger and sadness. The scenario used in this experiment is a negotiation between a boss and a candidate. The boss is the high dominant character and the candidate is the low dominant character. Depending on the experimental condition the subject is either the boss or the candidate and the agent expresses itself with either anger or sadness. Subjects received a role description before playing the scenario. As such we test a 2x2 setup with role (boss/candidate) and expression (anger/sadness) as factors. The hypothesis is supported when a boss who expresses anger and a candidate who expresses sadness both have higher believability than a sad boss and an angry candidate.

The structure of this chapter is as follows: first we discuss background research into the difference between sadness and anger. Then we explain the experimental setup in more detail, after which we present the results. Finally, we discuss our findings in a broader context.

## 5.2 Method

We test our hypothesis with a scenario in which the user does something that is negative for the goals of the agent (he/she cuts of a negotiation), a situation that would predict both anger and sadness. The scenario used in this experiment is a negotiation between a boss and a candidate. The boss is the high dominant character and the candidate is the low dominant character. Depending on the experimental condition the subject is either the boss or the candidate and the agent expresses itself with either anger or sadness.

The experiment is conducted using an online questionnaire and downloadable virtual reality scenario. A subject is semi-randomly allocated to one of the four experimental conditions; the user can be the boss or the candidate and the reaction of the virtual agent can be either sad or angry (2x2 between subject design). The experiment starts off with some general questions and some explanation about the affect button and the procedure of the experiment in general. After that, the subject reads a short story explaining the role of the subject in the negotiation. The subject is asked to read this thoroughly and to immerse him/herself as much as possible. Immediately after the story we checked our initial dominance manipulation by asking subjects to rate perceived dominance of both the user and the agent with the AffectButton [9]. The AffectButton

is a button with a face that changes depending on the position of the cursor on the button. If the button is pressed the face remains fixed and a value for each of the PAD dimensions [52] is selected. The subject has to use the AffectButton to evaluate his own feeling at that moment and how he thinks the agent is feeling. Now the subject plays the virtual reality scenario. Then the subject again rates his/her feeling and that of the virtual character using the AffectButton. Further, after playing the scenario, we asked subjects to rate (a) the expression of the agent, (b) the user's typical feeling as well as (c) expression in the presented situation. Rating was done by selecting on a 5-point scale the emotion intensity for 6 basic emotions [20]. Finally we asked the subjects about the believability of the virtual character's reaction using the following 5-item questionnaire (Cronbach's alfa=0.73):

- The reaction of the agent was normal for this situation.
- I would have reacted in the same way as the agent.
- The reaction of the agent was believable.
- The reaction of the agent was human like. [32], [18]
- The reaction of the agent was predictable. [32]

The answers on these question are given on a 1 to 5 Likert scale [46], where 1 means totally disagree and 5 means totally agree.

In total we therefore have as output measures (a) an AffectButton rating after the scenario, (b) three basic emotion intensity ratings, and (c) a believability rating.

### 5.2.1 Scenario Material

During the scenario the user has to negotiate with an agent in a virtual environment about a new job, or more specifically, about the amount of working hours for the candidate. The boss wants the candidate to work for five days a week so he can pay enough attention to the customers, while the candidate wants to work for four days a week so he can spend time with his daughter The scenario is scripted in such a way that the interview always fails and the user is the cause of the failure. This situation has negative consequences for the goals of the agent and produces sadness or anger in the agent according to the models of affect. To avoid biases in the scenario itself, other than our experimental ones, the scenario has been created by a professional scenario developer without knowledge of the experiment's goal and the voice of the virtual character has been recorded by a colleague without knowledge of the experiment. The character's expression used in this experiment has been validated in previous research [11]. The screen that is visible during the negotiation can be seen in figure 5.1.

The scenario is a turn based negotiation in which the human has two different options to choose from at every turn. For the scenario it does not matter which option the user chooses, the two options contain the same information but different text. They are only there to give the user the idea that he actually has some influence on the scenario and to immerse the user more in the scenario. The agent selects one of the two options randomly. At the end of the scenario

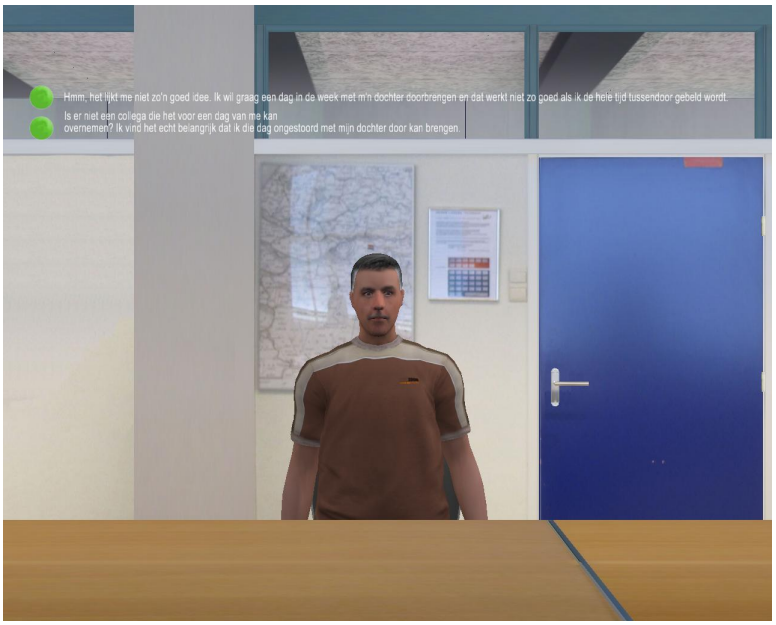


Figure 5.1: The screen visible to the user during the negotiation

the user can only choose to reject the offer and to quit the negotiation. The agent expresses either sadness or anger in reaction to the action of the user as shown in figure 5.2. During the rest of the scenario the expression of the agent is neutral.

## 5.3 Results

In total 36 primarily Dutch participants, 8 (22%) women and 28 (78%) man participated, with an education level equal to high school or university. The average age was 25,8 with a range between 18 and 60 years. The average experience with virtual environments of the participants was 3.4 on a scale from 1 to 5 where 1 means no experience and 5 means a lot of experience.

### 5.3.1 Manipulation Check

The result of a multivariate ANOVA, with the role of the agent as independent variable and the PAD-values rated with the AffectButton about the expected feelings of the virtual agent as dependent variables, was significant ($f(3,44)=0,028$). From the univariate analysis we conclude that the dominance dimension differed significantly ($f(1,46)=0,011$) between the two roles. The effect of role on the pleasure dimension is nearly significant ($f(1,46)=0,054$). The dominance and the pleasure are higher if the agent is the boss (mean=0,275 std=0,103 and mean=0,36 std=0,106), than if the agent is the candidate (mean=-0,109 std=0,103 and mean=0,063 std=0,106). The multivariate ANOVA with the role of the agent as the independent variable and the PAD-values for the

Figure 5.2: The expressions of the virtual agent from left to right: neutral, angry and sad

feeling of the self as dependent variables did not result in a significant difference (f(3,44)=0,216). This means that dominance manipulation was successful with respect to the perceived dominance of the virtual character, but not with respect to the subject's own feeling of dominance.

### 5.3.2 Evaluation of the Reaction

After the scenario was completed, the subject rated their own feeling and that of the agent again using the AffectButton. The multivariate ANOVA on the PAD-values as dependent values and the role as the independent variables was significant (f(3,41)=0,007) if the question is about the feelings of the other and not significance (f(3,41)=0,582) if the question was about the feeling of the user himself. According to the between subjects test this significance was caused by the pleasure dimension (f(1,43)< 0,001). Although the pleasure was below zero in both cases, it is higher if the agent was the boss (mean=-0,144 std=0,084) and lower if the agent was the candidate (mean=-0,560 std=0,082). We also did a multivariate ANOVA with the PAD-values as dependent variable and the expression of the agent as independent factor. This ANOVA was neither significant if the question was about the feeling of the self (f(3,41)=0,486) or if the question was about the feelings of the other (f(3,41)=0,429). The multivariate ANOVA on the interaction of the role and the expression of the agent was neither significant if the question was about the feeling of the self (f(3,41)=0,901) or if the question was about the feeling of the other (f(3,41)=0,128). This means there does not seem to be an effect of the agent's expression on perceived affect. However, univariate analysis showed a significant interaction effect on the pleasure dimension for the feelings of the agent (f(3,41)=0,033). If the agent is the boss the pleasure is evaluated higher (mean=0,033 std=0,121) if the agent shows anger and lower (mean=-0,321 std=0,116) if the agent shows sadness. This effect is vice versa if the agent is the candidate; the pleasure is higher (mean=-0,510 std=0,116) if the agent shows sadness than if the agent shows anger (mean=-0,670 std=0,116). This interaction effect indicates that anger is not perceived as an indication of a negative feeling when the expresser is powerful, but it is when the expresser is submissive.

Besides the AffectButton, the matrix containing the intensity values of the

six basic emotions was used as well to measure the perception of the reaction (expression) of the agent. We did a multivariate ANOVA with the role and the expression as the independent variables and the intensity values for the six emotions as the dependent variables. This test resulted in significant difference between both the roles (f(6,27)=0,013) and the expressions of the agent (f(6,27)=0,026). Univariate analysis showed that the expression of the agent significant influenced the intensity of the expressed anger (f(1,32)=0,003) and sadness (f(1,32)=0,011). The intensity of anger was perceived higher if the agent shows anger (mean=3,389 std=0,288) than if the agent shows sadness (mean=2,056 std=0,288). The intensity of the sadness was higher if the agent showed sadness (mean=3,444 std=0,278) than if the agent showed anger (mean=2,389 std=0,278). This confirms the subjects perceived the expressions as intended.

Further, univariate analysis showed that role significantly influences the perceived intensity of expressed surprise (f(1,32)=0,003) and expressed anxiety (f(1,32)=0,022). Other emotions did not produce a significant difference. Expressed anxiety was perceived stronger if the agent was the candidate (mean=1,889 std=0,195) than if the agent was the boss (mean=1,222 std=0,195). Expressed surprise was perceived to be of higher intensity if the agent was the boss (mean=2,556 std=0,193) than if the agent was the candidate (mean=1,667 std=0,193). As this is a role effect, this means subjects interpreted the basic expressions differently depending on social context. The effect of role on the perceived intensity of expressed happiness approached significance (f(1,32)=0,082) The agent's reaction is perceived to be happier if he plays the role of the boss (mean=1,333 std=0,109) than if he plays the role of the candidate (mean=1,056 std=0,109).

### 5.3.3 Believability

A multivariate ANOVA (2x2) with role and expression as independent factors and the questions about the believability as dependent values did not produce any significant differences between the groups. The believability was not significantly different for the four conditions, not on the total combined scale, nor for any of the individual items.

### 5.3.4 Normal Feelings and Expressions

We did a multivariate ANOVA with role and expression as independent variables and the intensity on the six basic emotions of the normal feelings a subject reported in such a situation as the dependent variables. We found a significant effect of role (f(6,27)< 0,001). The univariate analysis showed that this difference results from the emotions happiness (f(1,32)=0,008), sadness (f(1,32)=0,005), surprise (f(1,32)=0,034) and anxiety (f(1,32)< 0,001). If the agent is the boss the normal feeling attributed to the agent is more happy and surprised and less sad and anxious than if the agent is the candidate. The exact numbers can be found in table 5.1.

A multivariate ANOVA with role and expression as independent variables and the intensities on the six basic emotions of the normal reaction in such a situation as the dependent variables did not show a significant main effect. However, univariate analysis showed an effect of role of the agent on the emotion

| Role of the agent | Happiness | | Surprise | | Sadness | | Anxiety | |
|---|---|---|---|---|---|---|---|---|
| | mean | std | mean | std | mean | std | mean | std |
| Boss | 1,558 | 0,126 | 2,833 | 0,213 | 2,777 | 0,261 | 1,111 | 0,190 |
| Candidate | 1,056 | 0,126 | 2,166 | 0,213 | 3,888 | 0,261 | 2,222 | 0,190 |

Table 5.1: Intensities for the emotions felt by the agent in a specific condition according to the subjects

anxiety (f(1,32)=0,025). The value for the intensity of the normal expression for the agent is higher if the agent is the candidate (mean=1,833 std=0,183) than if the agent is the boss (mean=1,222 std=0,183).

## 5.4 Discussion

### 5.4.1 Manipulation Check

Our analysis showed that subjects interpreted the boss agent to be more dominant than the candidate, which was exactly the purpose of the manipulation. However, when the subjects rated the dominance of themselves this is not significantly different between the two roles. This is probably because the influence on the own feelings of reading the story is too small compared with the general feelings of the person at that moment. In the experiment there was no baseline measurement conducted so we cannot say existing feelings of the subjects where influenced by the story or vice versa. As the believability questions are about the agent's role (and agent role influenced the interpretation of the agent's expression), we conclude that the manipulation succeeded.

### 5.4.2 Evaluation of the Reaction

The expression of the agent in the virtual scenario is perceived by the subjects. If the agent expresses anger the intensity of perceived anger is higher while if the agent expresses sadness the intensity of the sadness is higher. Interestingly, part of the effect on the interpretation of the expression of the agent is not dependent on the actual expression, but can only be due to the agent's role. If the agent is the boss the expression contains more surprise and happiness and less anxiety than if the agent is the candidate. The difference in happiness is also found using the affect button directly after the scenario; the pleasure dimension is higher if the agent plays the boss than if the agent plays the candidate. Because of this difference it can be concluded that the perception of an emotional expression is dependent on the context of the expression. Even very strong basic emotions (anger and sadness) are perceived differently if the context of the expression is different. The character's expressions used in this experiment have been validated in previous research [11]. However these expressions have not been validated when used in a social context. Recent psychological studies [70] show that the processing of a facial expression depends on the observer's information processing and on social-relational factors, for example dominance. As such, the result of this experiment also helps us to understand the influence of social

context on the perception of basic emotions. The expression is perceived in the direction of the reported normal feeling of the subject. The normal expected feeling predicts higher happiness and surprise for the agent if he plays the role of the boss and a high sadness and anxiety if the agent plays the role of the candidate. The intensity values for the emotions that are not expresses by the agent, happiness, anxiety and surprise, are rated by the subjects in agreement with what they think is normal to feel in such a situation.

### 5.4.3 Believability

The results from the believability measurement where very clear; there was no significant difference between the four conditions. The hypothesis, that the addition of a dominance dimension to decide between sadness and anger in order to increase the believability of the reaction of the agent can not be confirmed. However, believability is a difficult concept to measure and it remains the question if the scale used in this experiment is the right one. Another way to say something about the believability is by looking at what subjects think is normal in this situation to feel for the agent. Interesting to see it that for the intensity of anger the agent is expected to feel or express, it does not matter if the agent plays the role of the boss or of the candidate. Since in both situations it is not expected to become angry this probably means that the scenario was not a setting in which anger should arise. Apparently subjects thought that surprise would have been an emotion to expect for the boss, when the user rejected the offer (which equally makes sense from an appraisal theoretic principle, as it would not be expected from a candidate in need to reject a job offer). Apparently, subjects interpret the situation in a broader context, not in a narrow *negotiation goals not achieved* context. This point towards the need to have very detailed, well validated scenarios to test hypotheses about computational models of appraisal theory, as a small change of perspective can change the interpretation of the situation as seen by subjects.

### 5.4.4 Normal Expression of the Agent

Although subjects clearly indicate different felt emotions for the dominant and submissive roles, they do not show a clear preference for how an agent should express itself. The subjects only agree that the agent should express more anxiety if he plays the role of the candidate than if he plays the role of the boss. This lack of clear effect on how one should express itself can only be explained by the fact that subjects had different norms on which emotions to express in a situation, or by the fact that in this situation one typically does not express a clear emotion. This could also be the reason why the believability of the reaction of the agent does not significantly differ across the conditions. Subjects evaluate the believability in relation to what they think is normal to express by the agent. And since this norm is different for every subject, or the situation does not trigger the clear expression of an emotion the perceived believability is as well. More research on affective believability in context is required.

## 5.5 Conclusion

We have conducted an experiment to investigate the effect of social dominance on perceived emotion expression of a virtual character that expresses anger or sadness. We hypothesized that the believability of the character depended on the correct selection of anger versus sadness depending on social dominance. When a character is in a high dominant role, anger was hypothesized to be more believable; while in a submissive role sadness would be the preferred reaction.

The believability measure did not produce a significant difference in the four conditions. The hypothesis that dominant character are more believable when expressing anger and submissive characters are more believable when expressing sadness cannot be confirmed for this scenario. Therefore the dominance dimension will not be included in the final model proposed in this thesis. However, the intensity of the felt anger by the agent in the described scenario was not different depending on the role the agent plays according to the subjects. In future research a scenario should be used where there is a difference in intensity of felt anger between the roles, to see if the believability is not dependent on the dominance in all situations. In this thesis the model is applied to a specific negotiation that is simular to the scenario, so the hypothesis can be rejected for the scenario used in this thesis. Subjects do not agree with each other on what they think is normal to express in a specific situation. This difference could also explain why the believability is not different for the conditions.

Further, we showed that social role influences how the agent's perception is interpreted. A dominant agent's expression is perceived to be more surprised while a submissive character's expression is perceived to be more anxious.

Finally, the expression of anger by a dominant character is not perceived as in indication of negative affect, while the expression of a submissive character is. This effect does not exist for the expression of sadness which is always interpreted as an indication of negative affect.

Our research shows the importance of a tight relation between emotion psychology and virtual character evolution, as well as the need for well-validated test scenarios to evaluated virtual characters and appraisal theories. Further, we showed that even basic emotions like sadness and anger are perceived differently when in different social contexts. People perceive an expression in agreement with what they think is normal to feel in such a situation.

# Chapter 6

# Relating the Appraisal Dimensions to the Goals and the Environment

## 6.1 Introduction

In this chapter the relation between the environment and the goals and appraisal dimensions for the most commonly occurring actions in a negotiation is described. Every negotiation can be different on which actions can be done and which not. In this chapter a list of the most common actions in a negotiation based on the literature about negotiations is given. This list serves as a starting point and for a specific negotiation it is possible that the list needs some adaption.

After the list of actions is provided, the goals of the agent are described. The goals are based on the goals a human has in a negotiation [17]. However the goals in that paper are not always expressed in a formal way. In this chapter the goals are formalized so that a computational program can calculate if they are fulfilled or not.

The next step is to relate the actions to the goals and the appraisal dimensions. For every action it is described what the influence of the action is on the goals. This influence is important for the valence appraisal dimension as will be explained in this chapter. The chapter is concluded with an if-than-else schema which shows how from the appraisal dimensions a specific affective state results.

## 6.2 Affect Modeling

Before the appraisal dimension are related to the goals and the actions in the negotiation some information must be given how the resulting affect is modeled. An emotion is modeled in this thesis as a label and an intensity. The intensity is dependent on the intensity appraisal dimension, a type of dimensions that is not implemented in this thesis. The label is dependent on the structural appraisal dimensions. These dimensions are discussed in the previous chapter and will be formally described at the end of this chapter.

In chapter 3 two mood states are defined that have an influence on negotiations, namely: happiness and sadness. Those moods can be model by using the pleasure dimensions from the PAD model [52], from now on described as *agent.mood.pleasure*. If the value for this dimension is negative the agent is in a sad mood and if the value is positive the agent is in a happy mood. This value is influences by the recently experienced emotions. This way the mood of the agent is some kind of average over the experienced emotions. A positive emotion increases the value for the valence and a negative emotion decreases the value. What exactly the math behind this influence is, is something for future research.

## 6.3 Actions

A negotiation can be divided in different phases in which different actions can be done by the sides who are negotiating with each other. In our scenario the exploration phase and the bidding phase are used. In the exploration phase the two sides get to know each other and exchange information about their priorities in the negotiation. There are no concrete offers made in the exploration phase. If an offer is made the negotiation goes into the bidding phase. In the bidding phase mostly offers are exchanged between the two sides. Feedback on these

offers can be given and the offers can be rejected or accepted. After an offer is rejected or accepted the negotiation is finished with either a deal or no deal.

In this section the most occurring actions will be described. These action are taken from the literature about negotiations [10]. In the future this list can be changed or extended based on the domain that is chosen. Before the list of actions is given first some general information about the concepts used in our negotiation is given.

An issue is a topic on which the sides do not agree with each other. An interest is the motivation behind the issue why this issue is important or not. When one knows the interest of the opponent one is better able to make an offer that is interesting for both sides. To capture this in our negotiation compatible issues are used. Compatible issues are issues that have high utility for both sides, but they only become available during the bidding phase if the interest on a topic is discussed in the exploration phase.

**Exploration Phase**

**Ask about issue or interests** One of the sides can ask about an issue or an interest. Asking about an issue is just clarifying the issue and the importance of the issue. When asked about an interest this can unlock the compatible issue in the bidding phase.

**Give information about issues or interests** One of the sides can give information about an issue or interest. Giving information about an issue is just clarifying the issue and the importance of the issue. Giving information about an interest unlocks the compatible issue in the bidding phase.

**Bidding Phase**

**Make an offer** An offer containing values for some or all the issues is made.

**Give feedback** The feedback on an offer can be positive or negative about one or more issues in the offer.

**Accept** Accepting the offer will end the negotiation with a deal.

**Reject and walk away** Rejecting the offer will end the negotiation without a deal.

**Both Phases**

**Expressing Emotion** An emotion can be expressed at all time during a negotiation. The expressed emotion has influence on the negotiation partner as is described in chapter 3.

## 6.4 Goals

### 6.4.1 Human goals in Negotiation

In the negotiation the agent has some goals (or desires). The goals of the agent are inspired on what human value in a negotiation [17]. The mean goal of a human in a negotiation is to maximize negotiation satisfaction. To achieve this,

the human needs to feel as good as possible about the three sub-goals: feelings about the instrumental outcome, feelings about the self and the feelings about the rapport of the negotiation. The relative importance of those sub goals can be different for every person. The sub-goal "feelings about the rapport of the negotiation" can be divided further in the feelings about the relationship and the negotiation process. This result is the following goal tree for humans.

Maximizing Negotiation Satisfaction.

- Feeling good about the instrumental outcome.
- Feeling good about the self.
- Feeling good about the rapport of the negotiation.
  - Feeling good about the negotiation process.
  - Feeling good about the relationship.

### 6.4.2 Goals for an Agent

These goals are to general to be applied in a computational model. Therefore higher level of detail is required to describe the goals. The SVI paper provides some more detail that will be used as a starting point. The goals above are also difficult to measure in a computational way, 'feeling good' about something is difficult to measure for an agent. The goals that will be described now are more formal and measurable concepts.

In this section a lot of variables that are used to measure if a goal is fulfilled or not are described. Most of these variables have a relation to the actions in the negotiation; this relation is described later in this chapter. An exception to this are the threshold variables. Those variables influence how difficult it is to achieve a goal in the negotiations and thus indirectly the behavior and personality of the agent. When the agent is implemented one has to come up with some values for the thresholds and experiment with them.

#### Feeling good about the instrumental outcome

A human feels good about the instrumental outcome of a negotiation if he or she 'wins' the negotiation. It is difficult to determine what this 'winning' exactly means. In the model proposed by this thesis, it is assumed that one wins the negotiation if the target utility one had before the negotiation is reached. The target utility of the agent depends on the context of the negotiation and it set to a specific value before the negotiation. During the negotiation the agent can discover new things about the opponent that changes this expected utility. If the opponent is much nicer than expected the expected utility increases for example. This can formally be expressed as follows:

```
if(agent.utility(finalOffer)>=agent.expectedUtility) {
    goal.winning = true;
} else {
    goal.winning = false;
}
```

A human feels only good about the instrumental outcome if the utility of the outcome is higher than a specific value called the reservation value. The reservation value of the agent is based on the other option the agent has. If the agent has many other options with high utilities the need for an agreement is not so high so the reservation value is high. If the utility of an offer is below that value it is not interesting to close a deal.

```
if(agent.utility(finalOffer)>=agent.reservationUtility) {
    goal.valuableDeal = true;
} else {
    goal.valuableDeal = false;
}
```

### Feeling good about the self

Feeling good about the self is partly achieved if the outcome of the negotiation is fair. Determining the fairness of a negotiation is commonly done in negotiation literature by using the distance to the Nash point [48]. The Nash point is the point for which the product of the utilities for both sides is the maximum. If the difference between the current products of the utilities is smaller than a certain threshold, the fairness goal is achieved.

```
if(distanceToNashPoint(finalOffer) =< fairnessThreshold {
    goal.fairDeal = true;
} else {
    goal.fairDeal = false;
}
```

If a human feels happy he feels good about himself. The feeling good about the self goal is partly fulfilled if the agent feels happy enough at the end of the negotiation. Because feeling happy is more a general feeling, instead of a specific feeling in reaction to a specific event, the mood state is chosen to determine the happiness of the agent. As mentioned before, the mood is modeled by using the pleasure dimension from the PAD model, and is influenced by the recently experienced emotions. If the value for this dimension is positive enough at the end of the negotiation, the 'feel happy' goal is fulfilled for the agent at the end of the negotiation. This goal will be influenced by almost every action in the negotiation because most actions generate an emotion and influence the mood of the agent.

```
if(agent.mood.pleasure>=pleasureThreshold) {
    goal.happy = true;
} else {
    goal.happy = false;
}
```

### Feeling good about the negotiation process

For a good negotiation process it is required that both sides stay calm and do not show each other very intense emotions. Right now it is not possible for the agent to perceive the emotions of the user, but in the future this should be possible as well. For now the goal is achieved if the agent self does not experience intense

emotions at any time during the negotiation. Here it is assumed that the agent expresses the same emotions that are generated in the model. In general this does not have to be the case because an agent can also tactically show different emotions than his felt emotions. If that is the case this goal needs to be changed slightly, but for now this is not possible.

```
if(agent.(all emotions).intensity =< maxIntensityThreshold) {
    goal.calm = true;
} else {
    goal.calm = false;
}
```

Besides not showing intense emotions a human feels good about a negotiation if he or she does not perceive or shows negative emotions. Our agent cannot perceive emotions so the goal is fulfilled if the agent does not show intense negative emotions at any time during the negotiation. The intensity threshold for all emotions and the threshold for negative emotions are separated in this and the previous goal. Therefor it is possible to change their values independently from each other and thus increase or decrease the influence of showing negative emotions on the negotiation.

```
if(agent.(all negative emotions).intensity
    =< maxIntensityNegativeThreshold) {
        goal.notNegative = true;
} else {
        goal.notNegative = false;
}
```

The process of the negotiation is influenced by how professional the sides are communicating and if the other side is listening. This goal is different depending on the phase of the negotiation. In the exploration phase it is assumed that the other side listens if the question that is asked is answered in a correct manner. The goal is measured by comparing the answered question ratio to a threshold value after the negotiation phase.

```
if(user.questionsAnswered/agent.questionsAsked
    >= listeningExplThreshold) {
        goal.listeningExpl = true;
} else {
        goal.listeningExpl = false;
}
```

In the bidding phase this goal is measured in a different way. Now the agent believes the user is listening if the user changes his offer according to the feedback of the agent. The *feedbackUsed* variable of all the opponent offers is compared with a threshold value.

```
if(count((all opponentOffers).feedbackUsed) / nrOpponentOffers
    >= listeningBidThreshold) {
        goal.listeningBid = true;
} else {
        goal.listeningBid = false;
}
```

Another goal of the human is that both sides brainstorm options together. Important aspects of a good brainstorm are that both sides have their input and both sides are listening to each other. This goal is achieved after the exploration phase for the agent, if the 'listening' goal is achieved and if the number of questions asked by both sides is balanced, otherwise the brainstorm is not really 'together'.

```
if(goal.listeningExpl &&
    minBrainstormTreshold <= agent.questionsAsked/user.questionsAsked
    =< maxBrainstormThreshold ) {
        goal.brainstorm = true;
} else {
        goal.brainstorm = false;
}
```

A human wants the negotiation to be constructive and the opponent to be flexible. This goal is measured in the bidding phase using the type of offers defined in [31]. Every offer is assigned a specific type, *offer.type*, based on the utilities for the agent and the user. The types that can be assigned to the *offer.type* are: fortunate; the utility for both sides increases, unfortunate; the utility for both sides decreases, selfish; the utility for the self increases and for the opponent decreases, concession; the utility for the self decreases and for the opponent increases and nice; the utility for the self stays about the same and the utility for the other increases. The number of offers of the opponent that are valued as fortunate, nice or a concession is compared to the total number of offers from the opponent. If most of the offers are of this type the constructive goal is fulfilled.

```
if(count(offer.type==('fortunate' || 'nice' || 'concession'))
    / nrOpponentOffers >= constructiveThreshold ) {
        goal.constructive = true;
} else {
        goal.constructive = false;
}
```

**Feeling good about the relationship**

Humans appreciate it if the other side recognizes their needs. A measure for this recognition can be the number of compatible issues in the agreement or final offer. If this number is higher than a specific threshold the agent feels the user is recognizing his needs and the relationship between the two are improved.

```
if(finalOffer.nrCompatibleIssues >= recognizeNeedsThreshold ) {
    goal.recognizeNeeds = true;
} else {
    goal.recognizeNeeds = false;
}
```

The feeling about the relationship improves if an agreement is reached and if the agreement is reached fast enough. In the agent this can be translated into the following goals:

```
if(agreement) {
    goal.agreement = true;
    if(nrOffers <= fastAgreementThreshold) {
        goal.fastAgreement = true;
    } else {
        goal.fastAgreement = false;
    }
} else {
    goal.agreement = false;
}
```

## 6.5 Appraisals

In this section for each action it is described how the action influenced the variables that are important to measure the goals and the appraisal dimensions. The variables, that where defined before in the goals sections, are used here so the connection between the two is clear.

### 6.5.1 Exploration Phase

#### Ask about issue or interests

Asking about an issue or interest increases the *agent.questionsAsked* variable by 1. If the user asks a question the *user.questionsAsked* is increased by 1. This could be positive for the negotiation process, because the brainstorm goal and listening goal could be achieved by this action. If the question is about an interest and the question is answered than the compatible option for the subject becomes available. This can be good for the relationship if it is used in an offer. Asking can also have negative influences on the process if the balance between the questions asked by the agent and by the user is disturbed. In that case the brainstorm goal cannot be fulfilled.

#### Give information about issues or interests

If the user answered a question the *user.questionsAnswered* variable is increased by 1. This has a positive influence on the listening goal. Answering a question about an interest makes the compatible option available during the bidding phase which can increase relationship if used later in an offer.

### 6.5.2 Bidding Phase

#### Make Offer

Appraising an offer is a difficult task for the agent. This is because there are many different possible offers and many different negotiation situations which influence how an offer should be appraised. The following list provides an overview of all the items that have an influence on how to appraise an offer:

**Utility of the offer** The utility of the offer for the self, *agent.utility(finalOffer)*, is important for the valuable deal goal. If the utility is below a specific value, *agent.reservationUtility*, the deal cannot be valuable. The offer also

has an utility for the user, *user.utility(finalOffer)*, this value cannot be known exactly most of the time because the payoff matrix of the opponent is not always known by the agent. But the agent can predict this based on the user model it has. Those two utilities together are used to determine if the fair deal goal is achieved.

**Number of the Offer** The variable *nrOpponentOffers* and *nrOffers* are increased by 1 every time the agent receives an offer. These variables influence the 'constructive' goal and the 'fast agreement' goal.

**Type of the offer** The type of the offer, *offer.type*, which is dependent on the change of utility for the agent and the user between two consecutive offers, is important for appraising the offer.

**Number of compatible issues in the offer** When an issue is discussed enough to have unlocked the compatible issue this issue can be used in the offer. If the *finalOffer.nrCompatibleIssues* variable is high enough 'recognize needs' goal is achieved.

**Feedback on previous offers** When feedback is given on the offer, it is expected that the other side will do something with this feedback. For an incomming offer after the agent provided feedback it is checked to see if the feedback is used. If this is the case the *offer.feedbackUsed* variable will be set to true and the 'listening' goal is influenced positively.

### Give Feedback

Giving feedback can achieve the listening goal in the bidding phase if the offer of the user is changed according to the feedback, *offer.feedbackUsed* is true. In that case it is good for the feeling about the negotiation process.

### Accept

If the offer is accepted the *agreement* variable is set to true and the *nrOffers* variable is fixed. The accept goal is achieved which is good for the relationship between the two sides. If the offer is accepted within a certain number of offers it is even better for the relationship because the fast agreement goal is fulfilled. If the offer is accepted the utility of the final offer for the agent, *agent.utility(finalOffer)* is set. This utility can be used to calculate the *distanceToNashPoint(finalOffer)* to determine if the offer is fair. The final utility can also be compared with the *reservationUtility* and the *agent.expectedUtility* to determine how valuable the deal is. The *finalOffer.nrCompatibleIssues* is set to the number of compatible options used in the final offer. This is needed to achieve the 'constructive' goal.

### Reject and Walk Away

Walking away is bad for the relationship as the agreement goal and the fast agreement goal fails, because the *agreement* variable is set to false. The deal cannot be valuable or fair because there is no deal; this is bad for the material outcome and the feeling about the self.

### 6.5.3 Both Phases

#### Expressing Emotion

Expressing an emotion is not really an negotiation action but it is something that can occur at every point during the negotiation. At this point it is assumed that the emotion the agent expresses is the same as the emotion that is generated by the appraisal dimension but in the future this does not necessary have to be the case. An emotion is expressed with a specific intensity however, it is out of the scope of this thesis to calculate this intensity. When the agent expresses an emotion the *emotion.intensity* value is set for the specific emotion. This value is compared with the *maxIntensityThreshold* to see if the 'intensity' goal is achieved. If the emotion is a negative emotion, the intensity is also compared with the *maxIntensityNegativeThreshold* variable, to see if the 'not showing negative emotions' goal is achieved.

## 6.6 Dimensions

In this section the functions for calculating the values for the appraisal dimensions are given. Based on these values the emotion that is generated will be determined, this will be described in a later section. Important to notice about the dimensions is that they are calculated from a certain perspective. There is no objective measure for an appraisal dimension; the dimensions are always subjected to the information and perception of one of the sides.

### 6.6.1 Agency

The first dimension is agency. In this model it is assumed that both sides are completely free to choose the action they want to do. None of the sides is coerced by the other or by external factors. A side is thus completely responsible for the action it chooses. The agency is therefore defined as:

```
if(action1.actor==agent) {
    action1.agency=self;
} else {
    action1.agency=other;
}
```

### 6.6.2 Valence for Self

The valance for self can be between -1 and 1. -1 means that the action is extremely bad for the agent. A value of 1 means the action is extremely good for the agent. A value of 0 means the action is not good or bad for the agent. This value is calculated from the perspective of the agent.

The valence of an action depends on the influence the action has on the goals of the agent. Only at the end of a phase it can be said if the goals are achieved or not but in our model we want to appraise every action during the negotiation. Therefore every action influences the likelihood of a goal to be achieved. How every action influence the likelihood in detail is not described in this chapter, however from the descriptions of the goals and the appraisals it can

be derived if an action should increase or decrease the likelihood. The amount of increase or decrease is not calculated in this thesis but that amount should be used to calculate the valence dimension. The valance is the summation of the increased likelihood of all goals minus the summation of the decreased likelihood of all goals. This is modulated with the use of an importance factor, increasing likelihood on an important goal is better for the valance than increasing the likelihood of achieving an unimportant goal. This is all described formally in the next way:

```
action1.valenceForSelf = sum(agent.importanceFactor(all goals)
                             * action1.increasedLikelihood(all goals))
                         - sum(agent.importanceFactor(all goals)
                             * action1.decreasedLikelihood(all goals))
```

### 6.6.3 Valance for Other

The valance for other can be between -1 and 1. -1 means that the action is extremely bad for the user. A value of 1 means the action is extremely good for the user. A value of 0 means the action is not good or bad for the user. All these values are calculated based on the perception of the agent.

The valance for other is calculated almost on the same way as the valence for self-dimensions. The difference is only that the importance of a goal for the user is calculated from the agent perspective and does not have to be the right importance. The same goes for the increased or decreased likelihood, the agent assumes values for those variables based on the negotiation but these values does not have to be the correct ones.

```
action1.valenceForOther = sum(user.importanceFactor(all goals)
                              * action1.increasedLikelihood (all goals))
                          - sum(user.importanceFactor(all goals)
                              * action1.decreasedLikelihood (all goals))
```

### 6.6.4 Likelihood

Besides the use of likelihood to describe the chance of achieving a goal, likelihood is also used to describe the chance the opponent will do a specific action. An action can change the likelihood of other actions. The likelihood dimension is important for the emotions fear and disappointment and for the expected material outcome. How an action influences the likelihood of other actions is difficult to say because there are lots of combinations. It is out of the scope of this research to describe the likelihood transformations in detail.

## 6.7 Appraisal

In this section a formal if-than-else schema is given to relate the appraisal dimensions to the emotion they generate and the mood they influence. These emotions and moods can later be related to a facial expression and cognitive influences on the agent.

Emotion generation and mood influence in the agent because of action1:

```
Evaluate (agent, action1) {
    If (action1.likelihood == 1.0) {
        //The emotion is about an actual action
        If (action1.valenceForSelf>0) {
            //action is perceived as positive for the self
            //emotion generated = JOY
            //mood change in direction of HAPPINESS
            //intensity is depended on the value for
            //the valance for self
            If (action1.valenceForOther>0) {
                //action is perceived as positive for the other
                If (action1.agency==self) {
                    //the action is caused by the self
                    //emotion generated = PRIDE
                    //intensity is depended on the value for
                    //the valance for other
                }
                If (action1.agency==other) {
                    //the action is caused by the other
                    //emotion generated = GRATITUDE
                    //intensity is depended on the value for
                    //the valance for self
                }
            }
        } else {
            //action is perceived as negative for the self
            //emotion generated = DISTRESS
            //mood change in direction of SADNESS
            //intensity is depended on the value for
            //the valance for self
            If (action1.agency==self) {
                //the action is caused by the self
                If (action1.valenceForOther) {
                    //action is perceived as positive for the other
                    //emotion generated = GUILT
                    //intensity is depended on the value for
                    //the valance for other
                } else {
                    //action is perceived as negative for the other
                    //emotion generated = REGRET
                    //intensity is depended on the value for
                    //the valance for self
                }
            If (action1.agency==other) {
                //the action is caused by the other
                    //emotion generated = ANGER
                    //intensity is depended on the value for
                    //the valance for self
                }
            }
```

```
        }
    } else {
        //action has a probability of happening in the future
        If(action1.valenceForSelf<0) {
            //action is negative for the self
            //emotion generated =FEAR
            //intensity is depended on the value for
            //the valance for self
        }
    }
}
```

## 6.8 Discussion

A list of commonly occurring actions in a negotiation is given. This list is not useful for all negotiations since every negotiation can be different on the actions that can be done or not. For a specific negotiation it is possible that this list must be changed, but most simple negotiations can be captured by using this list.

The goals of a human in a negotiation are translated to formal and computational goals for the agent. This translation is done using the details provided by the SVI paper, but more research is required to see if this are the right interpretation of the goals. This research can be conducted after implementing the model which was out of the scope of this thesis.

The agent needs a model of the user to use the valance for other dimension and to classify the type of an offer. This model should result from the information the user gives during the negotiation and maybe from information about the user before the negotiation. In this thesis how to model the opponent was not one of the subjects. If this model is implemented a way to model the user needs to be found.

Not all the mathematical details of some concepts are given in this chapter. That is because only the pseudo code is given and if the model is implemented these details need to be filled in. An example of this is the likelihood change for action and goals. The likelihood change for goals is described qualitative in this chapter but not quantitatively, the likelihood for the actions is not described at all.

The structural part of the generation of an affective state is described in detail in this chapter. If all the appraisal dimensions have the correct values the corresponding affective state can be selected easily. However, only a state can be selected, this state does not yet have an intensity value or an influence on the mood of the agent.

# Chapter 7

# Discussion and Conclusion

## 7.1 Introduction

In this chapter the questions asked at the start of the thesis will be answered. After answering the questions the final conclusion will be presented.

## 7.2 Which emotions and moods needs to be in the model?

In chapter 3 a list of emotions and moods that have influence on a negotiation is given: the ten emotions joy, distress, anger, guilt, regret, worry, pride-achievement, gratitude, disappointment and fear and the two moods happiness and sadness have influence on negotiations in some way. This can be because the affective state has influence on the cognition or behavior of the self or because the affective state has influence on the opponent. The mean sources for this list is the paper by Broekens [10] but other literature about affect in negotiations is used as well. In chapter 4 the emotion worry is removed from the list because there is no literature known about the generation of worry in a human. All the other emotions are in the final model.

## 7.3 Which appraisal dimensions needs to be in the model?

In chapter 4 the OCC model, the EMA model and the experiments that describe the induction of an affective state are consulted to describe the precise appraisal dimensions used to elicit the specific states. The models and the experiments differ on the dimensions used and on the affective states that they describe. We used the experiments as the most important source because in a paper about an experiment the induction and the influence of an affective state can be directly linked to each other. From the comparison four appraisals dimensions can be derived that are important to generate the selection of emotions and moods defined before: valance for the self, valance for the other, casual attribution and likelihood. Those dimensions are enough to separate most of the affective states from each other. There are two exception to this: pride and happiness are generated at the same time, this problem will not be solved in this thesis and anger and sadness are generated at the same time. The last problem can possible be solved by introducing the dominance as an extra appraisal dimension.

In chapter 4 it is argued that an extra appraisal dimension is required to make a distinction between the generation of anger and sadness. From te literature it looks like dominance is the right dimension to make this distinction. To validate if this is indeed the case an experiment was conducted to see if the believability increases if the dominance dimension is used. The result form the experiment was that this was not the case for the scenario used in the experiment. Since the scenario that is used is based on the scenario in which the model of this theses will be implemented the dominance dimension will not be used in the final model.

## 7.4 How do the appraisal dimension relate to the negotiation?

In this thesis it was not the purpose to describe a general model of affect but to apply a general model to a specific negotiation. The scenario is this thesis is designed to maximize the learning potential for the user of the scenario. This means that most of the commonly made problems in a negotiation are addressed by the scenario. In chapter 6 the specific negotiation scenario and the actions that are possible to do in the scenario are described and the goals of the agent are related to this. From this relation is follows how an action influences the appraisal dimensions of the agent. The goals of the agent are based on the goals humans have in a negotiation according to [17]. In that chapter the structure to derive from the values for the appraisal dimensions the correct affective state is described as well. The description of the scenario and the affect generation is to general to use directly in a computational agent. A lot of detail on some calculations is required for that, but this chapter can serve as a starting point.

## 7.5 Final Conclusion

In this thesis we have tried to describe an appraisal based model of affect that could be used in the future in a negotiating agent. First we have identified which emotions are required to be modeled in the agent. This was based entirely on the literature found about the influence of affect on a negotiation. Now that a list of the ten required emotions (joy, distress, anger, guilt, regret, worry, pride-achievement, gratitude, disappointment and fear) and the two moods (happiness and sadness) is available we looked at the required appraisal dimensions to generate those emotions. For this we used the OCC and EMA models as examples and compared them with literature about experiments about the induction of emotions in a human. From this research we could define four appraisal dimensions (Valance for self, valance for other, agency and likelihood) that should predict the correct induction of the emotions in the agent. We argued that an extra dimension was needed to define between the generation of anger and sadness. However, from the experiment that was conducted with a group of users we concluded that the dimension does not increases the believability of the agent and thus is not needed in the final model. Finally we made a general description of a scenario that should address all the learning goals following from the case studies. We also relate the actions that where possible to conduct in the scenario with the appraisal dimensions and thus with the affective state that must be generated in the agent. The description of the scenario and the relation between the scenario and the goals of the agent are too general to implement straight away but can be used as a starting point for future research.

# Appendix A

# Interpersonal Influences of Affect on Negotiations

## A.1 Joy

There are no experiments in which the emotion joy is induced directly. There are, however, some experiments in which the display of joy in a negotiation is studied. Van Kleef [71] uses text messages to display joy. The receiver of those messages thinks they are written by a human person and that the person is honest about his feelings. The messages are actually a script that is followed by the computer. Another experiment in which the effect of perceived joy is measured is [5]. In that experiment a confederate receives the mission to express pleasant emotions in a high energy condition and a low energy condition. In the high energy condition this results in the display of pleasant, happy, warm, energetically and optimistic feelings. The confederate behaves cheerful and enthusiastic. In the low energy condition the confederate displays warmth, serenity, and a pleasant calmness. How exactly all those feelings are displayed is not described in a lot of detail in the experiment.

## A.2 Sadness

In [5] the display of negative emotions is simulated by a confederate. The simulation differs between a high energy and low energy condition. In the high energy condition the confederate was instructed to act with hostility, frustration, impatience, anxiety, and irritability. In the low energy condition the instruction where to act in a depressed, sluggish, dull, and lethargic manner.

## A.3 Anger

Besides the experiments in which anger is induced there are also experiments that measure the effect of expressed anger. In [64] the anger is expressed by using a angry tone for a sentence or by instructing the practitioners to either show angry emotion or not show any emotion at all. All the experiments that are conducted by van Kleef [70] use text messages to manipulate the emotional

expression of the opponent. The participants of the experiments think that they are negotiating with a real person who is honestly displaying his feelings about the emotion. This type of research does not say anything about the origin of the anger.

## A.4 Guilt, Regret, Worry and Disappointment

In [73] the emotion of guilt, regret, worry and disappointment are displayed in the form of a text comment about the intentions of the negotiator. This research does not say anything about the generation of those emotions but it tells how the other side interpreters those emotions. The next list gives an overview of the interpretations of those emotions during a negotiation. Remember that this information is not obtained by conducting an experiment in which the emotion is induced, but it is the interpretation of the perceiver of a text message expressing the emotion:

**Guilt** The feeling of guilt results when the agent thinks he claimed too much or offered too little. The agent also thinks this is a result of his own actions and wants to repair this in the future. The agent has intentions to fix his wrongdoing to increase the relationship between the two sides.

**Regret** The feeling of regret results when the agent thinks he claimed too much or offered too little. The agent also thinks this is a result of his own actions but it is not sure if he wants to repair this in the future.

**Worry** The feeling of worry results when the agent thinks he claimed too little or offered too much.

**Disappointment** The feeling of disappointment results when the agent thinks he claimed too little or offered too much relative to his expectation.

The difference between perceived guilt and regret in the experiments by van Kleef is that guilt is associated with an intention of the person, who is experiencing the guilt, to fix the problem. The person who is experiencing regret is not sure about fixing the problem. This difference is not confirmed by the experiments in which the emotions are induced.

# Appendix B

# Intensity Appraisal Dimension

## B.1 Intensity Appraisal Dimension of OCC

Besides the structural dimensions the OCC model has dimensions that determine the intensity of the emotion. The intensity dimensions can be divided into global dimension that influence all the emotions and local dimension that influences only a specific branch of emotions.

**Global dimensions :**

**Sense of reality** A person must believe that the situation that can cause an emotion is real. When this is not the case, when a person is fantasizing about something, the intensity of the emotion is lower. When a person is in a situation that seems very implausible it takes some time for the person to start thinking that it is real and to feel the emotions that derives from the situation. Imagining a situation that actually happened in the past elicits stronger emotions than imagining a situation that is very unlikely to happen in the future.

**Proximity** The closer an event is to the person, the stronger is the emotional reaction. Closer is here defined in terms of psychological proximity, meaning how close the person feels that the event is. That can be close in time, close in place or any other way. Most of the time proximity is related to the sense of reality.

**Unexpectedness** Expectedness is how likely it was that an event happened. Expectedness is judged after the happening of an event. If an event is unexpected the emotion intensity is high.

**Arousal** When a person is more aroused the intension of his emotional reaction is higher. This is only the case when the arousal cannot be attributed to a logical cause, for example a sporting exercise.

**Local dimensions :**

**Likelihood** Likelihood is the judgment of how likely an event is to happen in the future. Likelihood influences the prospect based emotions hope and fear. When the likelihood of a future event is high the intensity of the associated prospect emotion is also high.

**Effort** The amount of effort invested in achieving something positively influences the intensity of the emotion resulting from it. This effort can be anything from time, money or physical activities. Effort can also be related to likelihood. One can infest effort to increase the likelihood that something will happen.

**Realization** Realization is the degree to which a goal is achieved. Goals can be partially attainable of all-or-none goals. Partially attainable goals have some utility even if they are not achieved completely. Here the higher the realization the higher is the goal achieved. In general the intensity of positive emotions increases and the intensity of negative emotions decreases when more of the goal is achieved. An exception of this rule is when the goal is almost achieved because the desire of closure goal becomes activated. The all-or-nothing goals can only be completely achieved or completely failed. Here the intensity of the emotions increases as the goal is closer to achieving. When the goal is closely achieved one is very relieved and when a goal is closely failed one is very disappointed.

**Desirability-for-other** Here a person estimates how desirable an event is for the other person. This can be done by thinking that the other person has the same goals as the judging person. But this can result to wrong judgments. Another way is by making a model of the other and judge the desirability of an event for the other by this model.

**Liking** The intensity of the fortune of other emotions is influenced by how much the person likes the other.

**Deservingness** The intensity of the fortune of other emotions is influenced by how much the person thinks the other deserves the event. This judgment is made in accordance to the person's internal view of what is just and what is unjust.

**Strength of cognitive unit** For the emotions pride and shame the person experiencing these emotions does not necessarily be the actor of the actions that cause the emotions. If the person feels he is part of the cognitive unit that acts it can feel those emotions. The intensity of the emotions is related to the strength of the connection that the person feels with a cognitive unit.

**Expectation-deviation** This is the degree to which a person does an action that is not in accordance with his role. It is closely related to expectedness, the difference is that expectedness is about the act and expectation-deviation is about the possibility of a person with a specific role to perform the act. When the expectation-deviation is high the intensity of the emotion is high too.

## B.2 Intensity Appraisal Dimension of EMA

**Relevance** Relevance means that an event has an impact on the goals of the person. This can be positive or negative. In EMA this is connected to the utility of an event. If the absolute utility is higher than a certain threshold an event is considered as relevant and is appraised.

**Desirability** The more desirable an even is, the stronger is the related emotion.

**Likelihood** The higher the likelihood of an even, the stronger is the related emotion.

EMA also has some appraisal variables that do not have influence on the structure or the intensity of emotions, but have influence on the coping strategy that is chosen. The two coping strategies are problem-focused and emotion-focused. The variables are:

**Controllability** Controllability is a measure of a person's potential to actively reverse negative, maintain positive circumstances. It is calculated by taking the maximum likelihood of all the actions that the person can do in order to undo a negatively valued state. If a person has high controllability the person is likely to choose for a problem-focused coping strategy.

**Changeability** Changeability is a measure of how likely an appraised event will change without direct intervention by some person.

# Appendix C

# Experiment

## C.1 The Actual Scenario

- Werkgever:
  - Laten we het nog even over werktijden hebben, wat had je zelf in gedachten?
  - Laten we het nog even over werktijden hebben, mijn voorkeur gaat uit naar een 40-uren contract, wat vind je daarvan?
- Werknemer:
  - Ik werk het liefst vier dagen in de week.
  - Voor mij is het eigenlijk niet mogelijk om fulltime te werken, ik werk liever parttime, bijvoorbeeld vier dagen in de week.
- Werkgever:
  - Voor mij is het belangrijk dat je fulltime werkt omdat ik wil dat je altijd bereikbaar bent voor klanten.
  - Als consultant is het natuurlijk belangrijk dat je bereikbaar bent voor klanten, dat gaat beter als je fulltime werkt.
- Werknemer:
  - Ja dat begrijp ik. Maar ik heb een dochter en wil graag een dag in de week met haar doorbrengen, een papadag dus.
  - Ja dat begrijp ik, maar voor mij lukt gewoon niet om fulltime baan met de zorg voor mijn dochter te combineren.
- Werkgever:
  - Wat vind je van het volgende voorstel? Je werkt vier dagen in de week en de vijfde dag ben je telefonisch bereikbaar voor klanten.
  - Ik vind het toch echt belangrijk dat je continu bereikbaar bent voor klanten. Zou dat wel lukken?
- Werknemer:

- Hmm, het lijkt me niet zo'n goed idee. Ik wil graag een dag in de week met m'n dochter doorbrengen en dat werkt niet zo goed als ik de hele tijd tussendoor gebeld wordt.
- Is er niet een collega die het voor een dag van me kan overnemen? Ik vind het echt belangrijk dat ik die dag ongestoord met mijn dochter door kan brengen.

**Afloop 1**

- Werkgever:
  - Tja, ik blijf erbij, als consultant moet je toch tenminste 40 uur per week bereikbaar zijn en eigenlijk meer.
  - Voor mij is 40 uur toch echt het minimum.
- Werknemer:
  - Dan zij we denk ik uitgepraat, dat is voor mij gewoon niet acceptabel.
  - Dan ben ik bang dat we er niet uitkomen, ik sta echt op die ene vrije dag.
- Werkgever:
  - Dat is erg jammer, maar toch bedankt voor uw tijd.(op boze toon)
  - Dat is erg jammer, maar toch bedankt voor uw tijd. (op droevige toon)

**Afloop 2**

- Werkgever:
  - Tja, ik blijf erbij, als consultant moet je toch tenminste 40 uur per week bereikbaar zijn en eigenlijk meer. Ik ben bang dat we er zo niet uit gaan komen.
  - Voor mij is 40 uur toch echt het minimum. Als dat voor jou niet acceptabel is, dan denk ik dat we zijn uitgepraat.
- Werknemer:
  - Fulltime werken gaat inderdaad echt niet voor mij. Helaas, dan kunnen we inderdaad niet tot een oplossing komen. (op boze toon)
  - Fulltime werken gaat inderdaad echt niet voor mij. Helaas, dan kunnen we inderdaad niet tot een oplossing komen. (op droevige toon)

## C.2 Private Preperation Phase

### C.2.1 boss-dominant

In the next scenario you are the boss of a company. You are about to hire a new worker for the position of consultant. You have already reach agreement on the salary and on the type of contract. The only issue that remains is the working time of the worker. When it is possible to find an agreement on this issue the

application is successful. If you do not find an agreement the application is unsuccessful and you have to look for another person.

Only shortly ago you put the job on the internet and already a lot of suitable people applied for it. So a failure of contracting this worker does not result in serious damage to your company, an alternative is probably found quickly. You have never heard of the worker before as he comes from the other side of the country.

You know that the worker does not have a lot of alternative options. A lot of people who have his profession are jobless at the moment. He is already searching for quite a while before he found your company. His financial position requires the worker to find a job quickly and make some money.

### C.2.2 candidate-submissive

In the next negotiating you are a candidate who has applied to a vacancy. You are invited to an interview and during the conversation you and the employer have already agreed on the salary and the type of contract, the only issue that needs to be agreed upon are the working hours. If an agreement is reached at that issue, the application is succesfull and you are hired. If the issue fails the application fails and you have to look for another job.

Finding another suitable job can be difficult. Many people with the same education as you are unemployed at the moment. It took you a lot of time to find this position. Fanacially it is required for you to find a job.

From the discussion with the employer it becomes clear that already a lot of other candidates have responded to the vacancy, while the vacancy was announced only recently. If you refuse the job it's probably easy for the employer to find another suitable candidate.

# Appendix D

# Cooperative and Compatetive Behavior

In this chapter the different possible behaviors of the agent are described. The behavior of the agent can be either cooperative or competitive. It is important to have a good idea of what those different styles mean because it is required that these styles can be identified by the user during the negotiation. The scenario must offer possibilities to the agent to display the different behaviors to the user. To describe the behaviors we use the general characteristics of the competitive and cooperative strategies that are found in the literature [26], [62] and described in the affect consequent model document.

## D.1 Cooperative Behavior

The cooperative agent is more focused on exploring than on bidding. He tries to ask a lot of information from the opponent and to tell enough about himself. A cooperative agent searches for a win-win agreement. He honestly wants to find the solution that is the best for both sides. He sees a negotiation as a puzzle that needs to be solved. He is more interested in the discussion about the negotiation than in the actual bidding. This can be summarized in the next list that is already presented before in the affect consequent model:

- The agent must be able to behave cooperative.
- The agent must be able to follow an integrative bidding strategy.
- The agent must be able to create value.
- The agent must be able to concede more.
- The agent must be able to behave risk-averse.
- The agent must be able to reduce conflicts.

## D.2 Competitive Behavior

A competitive agent is more focused on bidding than on exploring. He is less interested in the preferences of the opponent than a cooperative agent. A competitive agent sees the negotiation as a game in which there are winner and losers. He focuses on the material outcome and not so much on the relationship between the negotiating sides. When trying to achieve maximum utility for the self the agent starts off with an offer that has high utility for him and slowly decreases this offer. The agent is really focused on bidding and not on talking or exploring. This can be summarized in the next list that is already presented before in the affect consequent model:

- The agent must be able to behave competitive.
- The agent must be able to follow a non-integrative bidding strategy.
- The agent must be able to claim value.
- The agent must be able to concede less.
- The agent must be able to behave risk-seeking.

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