

A Computational Model Of Human Emotion

by

Robert L. Warner

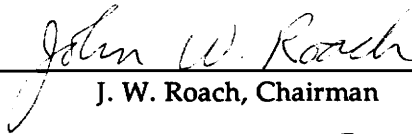
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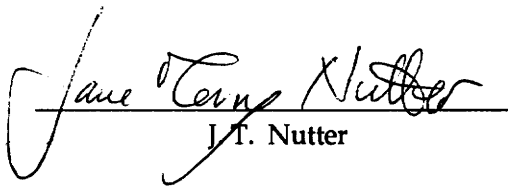
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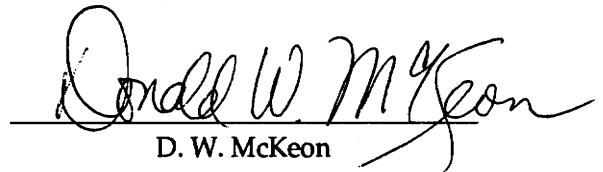
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(ABSTRACT)

To date, few computer programs have been constructed to express or understand human emotional states. None of these programs can detect a large spectrum of emotions from emotional situations, nor do any of them express emotions over more than one temporal dimension. A number of these programs used representations with domain restrictive structures. We have constructed a computational model of emotion that detects twenty-eight emotions and is non-domain specific. It reports emotional episodes, moods, and dispositions. The psychological theory behind the model draws extensively on the ideas developed in the book "The Cognitive Structure of Emotions," by Ortony, Clore and Collins [Ortony et al. 1988]. To test the model, we implemented a contextual front end to the system to provide input data. The domain chosen was doctor/patient interaction scenarios. Because our model is domain independent, any context could have been chosen, and other such contexts are explored in this paper. Our model demonstrated its ability by detecting a considerable range of appropriate emotions from the test case.

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1. Introduction

When one human communicates with another human, information is being transferred, analyzed, and represented. The analysis is colored by previous understandings and ideas of the speaker and the listener. One prevalent facet of these “understandings and ideas” is emotion. To see this, consider the scenario of a lawyer meeting her client for the first time. The client has been accused of murder, but believes he is innocent. The client must soon face trial and possibly prison. Knowing these facts, the lawyer talks gently with the client to lighten his distressed mood. She castigates his accusers to share in the client’s reproach. As a result the client likes the Lawyer and approves of the lawyer for her sympathetic acts. The client hires the Lawyer. Finally, he rewards her and secures her favor by offering to pay her handsomely.

From this scenario, it is clear that our emotions and our understanding of the emotions of others play an important role in our analysis of communication. Understanding the emotions of others helps us to perceive their communication in a new light. It helps us understand what kind of persons they are, what things are important to them, how much they like things and other people, and even what motivates them. We can respond to the communications and needs of others more effectively if we understand their emotions.

An important goal being strived for by researchers in the field of computer science is to enable computers to interface with human beings in more natural and satisfying ways. Getting computers to understand how humans communicate and think is critical to the achievement of this goal. Because emotion is so intertwined in human communication and thought, computers will not be able to understand these notions without an understanding of emotion.

As we will see in the next chapter, attempts to understand, model, and analyze emotions by computer models have been very limited up to this point in time. Most of these attempts do not present a general model of emotion. Rather, they are geared to specific contextual domains. In this thesis, we will explore our implementation of a broad computational model of emotion that does not depend on context. This model examines the communications of agents and deduces their emotions. These emotions are implied by specific acts, utterances, and personality characteristics of the conversational participants. For reference purposes, we call our model "COMOE," for "COMputational Model Of Emotion."

To be exact, COMOE detects the emotions of participants in a contextual scenario. It does not generate emotions. This detection process is needed for a computer to understand human communications and motivations. It is certainly possible that a computer could be given a "personality" and placed within a contextual scenario, in which case our model could detect the computer's emotions. This computer scenario however, would be artificially

contrived. We are more interested in the detection and understanding of emotions in real human settings.

Before continuing, we must state that our goal is to achieve rudimentary emotion detection on the computer. The complexities of emotional manifestations are great, and our model does not attempt to discern more than some of the most basic eliciting conditions and factors of emotions. In pursuing this modest objective, our model attempts to go well beyond the capabilities of any past computational model of emotion.

The setting we have devised as an input test case for our model presents a scenario in which a patient has come to a doctor to seek diagnosis and treatment. We chose this context because it very commonly occurs in our society and because it elicits a wide range of emotions with differing intensities. The model could have been tested with any other context, but this context puts a great deal of stress on the model, making it a worthy testing scenario. Here is an example of the emotions our model detected as a result of an act in this scenario:

******* DOCTOR'S EMOTIONS to: Patient> ThankDoctor (great)**

----- Episodes ----->

High JOY associated with
the Doctor's desire to SatisfyTheCurrentPatient.

Medium-high PRIDE towards Doctor

...no object emotion...

This implies a compound emotion of high SELF_SATISFACTION.

----- Mood ----->

High RELIEF associated with
the Doctor's desire to FindThatThePatientHasNoAilments.

Medium-high PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...

High PRIDE towards Doctor

Medium LIKING for Patient

There is a disposition/episode compound emotion of high SELF_SATISFACTION.

This model output shows the doctor's reaction to the patient's gratitude after being cured of cancer.

To express the construction of the model and the test scenario in this thesis, we will proceed in the following way: In the chapter following this one we will examine the history of computational emotion models and express the psychological roots of this model. In the next chapter, entitled "A Computational Solution to Modeling Emotions," we will provide an overview of how the model was constructed and how it operates. In chapters four through nine we will fill in the details of the model and provide an in depth understanding. In the tenth chapter, we will describe the nature of the test case and explain what kinds of information need to go into such test cases in general. In chapter eleven, we will analyze and show examples of the output of the model, given the test case as input. In the last chapter, we will discuss how the model would react to some other test case scenarios. We will also discuss the model's overall achievements and how it could be improved to achieve more.

2. Background Literature Review

Throughout the history of modern psychology, a number of different approaches to understanding emotions have been developed and considered. These psychology “schools of thought” have divided into five basic divisions: Physiological theories, Behavioral theories, Cognitive theories, Psychoanalytical theories and Humanistic theories. In the first section of this review, we examine these approaches to understand where our model fits into the spectrum.

While it is true that psychology has been evolving and developing for centuries, modern computers capable of rendering interesting models of emotions have only been around for about a quarter of a century. In those twenty five years, only a handful of computer programs have been developed to model or understand emotions. Four of these programs, ELIZA, PARRY, ALDOUS, and BORIS, are particularly important, and by examining them we can better understand the advances of our own model. Sections two through five of this chapter are devoted to this purpose.

Any model attempting to understand something as complex as a human being requires a theoretical foundation. The primary core of our model came from some particularly insightful ideas developed at the University of Illinois

at Urbana. Urbana psychologists Andrew Ortony and Gerald Clore, together with Allan Collins from Bolt, Beranek, and Newman developed their theoretical model of emotion with the intention that it be explicit enough to eventually encode into a computer [Ortony et al. 1988]. Their model was further enhanced by Ahmed Bouzid at Virginia Polytechnic Institute and State University to include the three temporal dimensions of emotional episodes, moods and dispositions [Bouzid 1990]. We examined these works in detail and made our own additions and revisions. Ultimately we achieved the final goal of an actual computer implementation of the model. In the last section of this review, we will examine the Ortony group concepts in detail, and explore the changes made by Bouzid.

Viewpoints of the Origin of Emotion

Ahmed Bouzid, in his master's thesis on meta-communication, provides a useful overview of the various schools of thought in the field of psychology [Bouzid 1990]. After examining his overview and comparing it to the descriptions provided by various introductory books (see [Hilgard et al. 1975] and [Freedman 1982]), we have constructed our own overview of these schools of thought with respect to their approaches to understanding emotion. We present them here to provide the reader with an brief understanding of these approaches, and to indicate which school of thought our model is most closely aligned with.

Bouzid explains that psychological viewpoints have been divided into four

separate traditional schools of thought: the Physiological theories, the Behavioral theories, the Cognitive theories and the Psychoanalytic theories. The concepts developed by most of the great theorists of psychology can be placed in one of these four schools. There is also a fifth school of thought that has come into being more recently that embodies "Humanistic" theories (as described in [Hilgard et al. 1975] and [Freedman 1982]). We will explore this new controversial school at the end of this section.

The Physiological theorists hold that emotions are produced by bodily responses to stimuli. Their idea is that emotion is not a product of thought, conscious or otherwise. Emotions are constructed by a series of bodily elements such as glands or nerves being directly stimulated by external phenomena. These elements cause a chain reaction that might involve heart rate increases/decreases, muscle excitement/atrophy, physiological pleasure sensations, and many other effects. The effects combine to form a state of emotion. These notions summarize the views of Descartes and Hume. Bouzid points out that William James, who came after Descartes and Hume, also agrees with the physiological origin of emotion, but asserts that it is not the combined physiological effects that form a state of emotion, but rather the personal observation of these effects. For example, noticing that your heart rate has increased and your muscles are twitching and jumpy causes you to experience fear.

We agree that physiological phenomena can have an impact on one's emotional state. Extreme cases of this are exhibited by psychiatric patients

who exhibit intense levels of emotions that cannot be explained through rational thought. Chemical imbalances in the brain can physically cause emotions to occur without the presence of external stimuli. In recent years, psychiatrists have been successful in treating many of the excessive emotional conditions, such as severe depression, through the use of chemical therapy.

It is probably reasonable to assume that people in general normally experience some emotion induced by physiological causes. It is also rather obvious, however, that the stimulus of so many of our emotions is rooted in more analytical origins. External causes of emotion are usually too complex to be identified by simple physiological receptors. For example, my body cannot perceive the loss of a job, the success of a project, political repression by a government, the death of a grandfather, the danger of final exams, and so many other events that stimulate emotions, without intricate cognitive analysis.

The Behavioral school explains emotions in a different way. This school holds that we behave in certain ways which when perceived later indicates to us what our emotional state is. For example, consider the person who sits around the house all day, with his head down, staring at the floor, exclaiming that life is no longer worth living. This behavior indicates that the person is sad. This observation indicating emotion seems similar to James' ideas, except with James it was observing physiological phenomena rather than behavioral phenomena. Darwin found this view of emotion particularly useful because he wanted to explore the utility of emotions. If an emotion is

simply a behavior with a purpose, then this utility can be discerned.

The main problem with this theory is that it does not attempt to understand what causes the behavior and consequently the emotion. Consider the earlier example of the person who sits around the house all day, with his head down. What caused him or her to be like that? Perhaps there was a death in the family, or a loss of a job, or perhaps he or she is physiologically predisposed to act that way. Is the behavior causing the emotion, or is the event that caused the behavior also causing the emotion? Clearly under either assumption, it is the eliciting event which is at the root of the matter. If the eliciting event is unknown, then the behavior is all we have to go on. If the eliciting event is known, however, it makes sense to us to investigate it in determining emotion.

It is the pursuit of understanding eliciting events and how they effect thought that makes the next psychology viewpoint a powerful one. The Cognitive approach contends that emotions are caused by conscious thoughts. Bouzid explains it this way:

“...according to the adherent of the *cognitive theories* of emotion, the perceiver’s cognition of the situation, how he sees things, what he believes and how he evaluates what he sees, are fundamental in the definition of what an emotion is.”

To see how different this idea is from the other ideas we have explored so far, consider the following situation: Peter was fired from his job today. The

physiological theorist would probably have a very difficult time explaining why Peter is unhappy. There is no physiological pain affecting Peter. None of his sensory organs are picking up anything uncomfortable. If Peter was hanging out in a bar getting drunk and crying into his glass, a behaviorist would be able to tell that Peter was unhappy, but the behaviorist would not understand why. The cognitive theorist would look at Peter's mental goals such as being successful, making a living, and providing for his wife and kids. The cognitive theorist would postulate that Peter was unhappy because losing his job is causing Peter to realize that these goals have been derailed.

The last school of psychological thought, the Psychoanalytic school, is centered around the work of Sigmund Freud. The main distinction that Freud makes is that much of the thought behind emotion is not conscious, but rather subconscious. He also holds that this subconscious has an incredible memory, capable of dwelling on the past constantly and applying the past to current situations. One could say that Freud was really a cognitive theorist, except that his theories hold that the mental process of constructing emotions is based much more on the past than most cognitive theorists believe and that cognition itself occurs in the back of the mind without the awareness of the person experiencing the emotion.

The controversial fifth school of psychology that we mentioned earlier has not enjoyed much scientific support, partly because of its desire to take science out of psychology. This is the school referred to as "Humanistic." Philosophers such as Nietzsche and Sartre belong to this school. It holds that

emotions are really a tool used by people to change their perception of the world in such a way so that it is more attuned to their mental state. We wish to grow and “self-actualize” in our perceived world and emotions may help us to switch to a world were these goals are more readily facilitated.

The main trouble with Humanistic thinking is that it is not concretely defined, making it practically impossible to model. It seems incapable of predicting emotions without dipping into the other schools of thought. Modern psychologists generally use its principles as an aide to psychological counseling, rather than emotion detection. It holds that each human is completely different, and the notion of common emotional motivations is practically an oxymoron. This makes the Humanistic school rather useless in developing general emotion models.

We believe that the cognitive approach has the most promise in terms of trying to discern the emotions of others based on their experiences and acts. When there is little background information to draw on, the behaviorist approach could also be fruitful. Physiological theories are able to identify the causes of some emotions - especially in moods and dispositions, but seem unable to grasp the complexities of general emotional experience. Psychoanalytical theories closely mirror the cognitive approach, but require the modeling of subconscious thinking based on a collage of past memories. How these past memories come together with current events to produce emotions is not well understood, so a computational model based of these concepts would be highly subjective.

Deception with ELIZA

The first program that seemed to contain some understanding of emotion was ELIZA. ELIZA was written on an IBM mainframe at MIT in the mid sixties by Joseph Weizenbaum [Weizenbaum 1966]. ELIZA was a strong model of artificial intelligence, meaning that it tried to simulate a human being, rather than explore some subtopic of human intelligence. Specifically, ELIZA pretended to be a behavioral psychologist. In theory, such a program would have to have some understanding of emotion. Consider the following dialog with ELIZA and a user, as reported by Weizenbaum:

User: Men are all alike.
ELIZA: In what way?
User: They're always bugging us about something or other.
ELIZA: Can you think of a specific example?
User: Well, my boyfriend made me come here.
ELIZA: Your boyfriend made you come here.
User: He says I'm depressed much of the time.
ELIZA: I'm sorry to hear you are depressed.
User: It's true, I am unhappy.
ELIZA: Do you think coming here will help you not to be unhappy?
User: I need some help, that much seems certain.

It certainly looks convincing. Note how ELIZA seems to understand what depression and unhappiness is. Also note how ELIZA fits into the behaviorist technique of asking bland questions to elicit unbiased responses.

When one actually examines how ELIZA responds the way it does, however,

it becomes clear that no real understanding of emotion is possessed by ELIZA. ELIZA simply plays certain word games that appear to produce 'intelligent' results. Consider some of the strategies used by ELIZA:

- If there are no "key words" found in the user's sentence, ask a stock question, such as "In what way?" or simply repeat the sentence.
- If the only "key words" found in the user's sentence are pronouns, use the antecedent of the pronoun to make a repeated sentence more intelligent looking.
- If a "key word" such as "depressed" occurs, produce a stock sympathetic phrase.
- Construct new questions by adding stock joining clauses to rephrasings or pronouns of the user's sentence. Examples of these clauses include "What would it mean to you if..." and "What else comes to mind when you think of..."

Looking at these kinds of rules, it is clear that ELIZA is not considering the user's emotions, nor does it understand emotions. The next program we are going to explore takes the ELIZA concept farther and actually becomes emotional.

PARRY's Improvement

PARRY is a program that simulates a paranoid psychiatric patient. It was written by Kenneth M. Colby, Sylvia Weber and Franklin D. Hilf in the early seventies at Stanford University [Colby et al. 1971]. PARRY suffers from delusions, that is, fears not grounded in fact, typically found in cases of

paranoia. Consider the following dialog between PARRY and a psychiatrist interviewer:

Interviewer: Why are you in the hospital?
PARRY: I shouldn't be here.
Interviewer: Who brought you here?
PARRY: The police.
Interviewer: What trouble did you have with the police?
PARRY: Cops don't do their job.
Interviewer: What do they do instead?
PARRY: Cops arrest the wrong people.
Interviewer: They arrest the right ones sometimes.
PARRY: The law should get those Italian crooks.
Interviewer: Are you Italian?
PARRY: My background is British, but I was born in this country.
Interviewer: Do you know any Italian crooks?
PARRY: I try to avoid the underworld.
Interviewer: Are you afraid of the underworld?
PARRY: The Mafia are the worst gangsters.
Interviewer: Are you connected with the Mafia?
PARRY: You know, they know me.
Interviewer: How do they know you?
PARRY: They spy on me.
Interviewer: Why do they?
PARRY: They want to get false evidence to frame me.

Note that both ELIZA and PARRY have the same sort of input/output paradigm, that is, they both process an input statement or question and generate an output statement or question. While ELIZA's processing is very simple, consisting of the sort of direct rules mentioned earlier, PARRY's rules are more complex, though in a similar vein. PARRY has biographical information stored in its data base, and thus it is able to answer questions, rather than avoid them as ELIZA does. The main advance PARRY has over

ELIZA as far as we are concerned, however, is that PARRY models an internal emotional mood as part of its input/output processing.

When the interviewer asks PARRY a question, PARRY looks for key words that might indicate malevolence. PARRY reacts to this perceived malevolence by increasing one or more of its three mood emotions, namely fear, anger, and mistrust. Over time, however, these emotions will die down if no further malevolence is perceived. The state of these mood emotions partially dictate what phrase PARRY will output. For example, if PARRY's level of anger is high and its level of fear is low, PARRY will refuse to answer the interviewer's questions and verbally attack the interviewer.

The trouble with PARRY's model of emotion is its "key word" approach. PARRY does not understand what emotions are. It simply associates key words directly with a particular emotion. For example, if the interviewer asks "Do you place bets on the horses?", PARRY identifies the word 'bets' as a "flare concept" (i.e., a word that initiates an emotion) and rises its internal level of fear. PARRY has no idea why a paranoid patient would find betting on horses fearful. PARRY has no understanding of the general causes of fear or anger, it just initiates them when key words within its specific paranoia context are discovered. Still, at least PARRY actually considers emotional states, whereas ELIZA attempted no internally evident treatment of emotions. ALDOUS, the next program we will examine, is very different from ELIZA and PARRY. Unlike these programs, ALDOUS considers an emotion to be caused by a combination of past emotions.

A Generic Model: ALDOUS

ALDOUS, written by John C. Loehlin in the mid sixties, is a very small program [Loehlin 1968]. It ran originally on a Burroughs 205 computer, with a memory capacity of 4 kilobytes. Compared with PARRY, which consisted of 35 kilobytes, or ELIZA, which was probably similar in size to PARRY, ALDOUS is almost one ninth their size. The computational model we have constructed is approximately one hundred and ten times the size of ALDOUS. Within ALDOUS's minuscule framework, however, it was able to model fear, attraction (or love) and anger. These emotions were directed towards objects such as "adult males with dark hair" and also exhibited as an emotional moods.

To say that ALDOUS models emotions is probably incorrect. It is more accurate to say that ALDOUS represents emotions. Specifically, ALDOUS represents its old emotions toward objects and its current emotional mood in memory. ALDOUS then constructs new emotions with an algorithm that bases its output on these previously represented emotions. For example, if a "blonde female teenager" was given to ALDOUS as input, ALDOUS would look in its memory for emotional references to blondes, females, teenagers, blonde females, blonde teenagers, female teenagers and blonde female teenagers. It would also reference its current mood, which would be equal to its last emotional output. Based on the combination of ALDOUS's emotions toward all these similar objects, and its current mood, ALDOUS would assign a new emotion toward the blonde female teenager. ALDOUS also would

produce an emotional action such as injury, frustration and satisfaction, in response to the emotions of fear, anger and attraction, respectively.

While it is true that ALDOUS handles emotions in a more generic way than PARRY, it is also true that ALDOUS, like PARRY, does not understand the causes or definitions of emotion. ALDOUS has no idea why it feels 'fear' towards an object. All it knows is that fear was felt towards similar objects in the past. Why it felt fear in the past is also not known. The fact that fear comes from the anticipation of the prospect of something bad happening is not considered by ALDOUS. ALDOUS's simple representation scheme does not encode such underlying cognitive foundations for emotions.

The Representational Breakthrough of BORIS

ELIZA, PARRY and ALDOUS were simple and tended to use extremely simplistic solutions to complex problems, such as understanding emotions. One of the reasons for this was that they were all written many years ago on very limited computers that were both slow and, more importantly, had very small memory capacities. The next program we will examine did not suffer from such limiting factors. It was written in 1982 by a graduate student of Yale University named Michael G. Dyer. Dyer's program, named BORIS, was the first to actually account for the causes and structures of emotions [Dyer 1983].

The purpose of BORIS was to read stories and try to understand them. BORIS's performance was tested through question/answer sessions,

conducted after BORIS had scanned a given story. BORIS could digest just one form of story, but story variations within this form could be constructed. An example paragraph of one of BORIS's input stories is as follows:

Richard hadn't heard from his college roommate Paul for years. Richard had borrowed money from Paul which was never paid back, but now he had no idea where to find his old friend. When a letter finally arrived from San Francisco, Richard was anxious to find out how Paul was.

Here are some of the questions BORIS answered about this:

Question 1: What happened to Richard at home?
BORIS: RICHARD GOT A LETTER FROM PAUL.
Question 2: Who is Paul?
BORIS: RICHARD'S FRIEND.
Question 3: Did Richard want to see Paul?
BORIS: YES, RICHARD WANTED TO KNOW HOW PAUL WAS.

There was also an emotional question:

Question 4: How did Richard feel when the letter appeared?
BORIS: RICHARD FELT GLAD BECAUSE PAUL AND HE WERE FRIENDS.

BORIS answered more emotion related questions as the story progressed, for example:

Question 5: Why was Paul upset about the divorce?
BORIS: PAUL AND SARAH WERE FIGHTING OVER THE FAMILY POSSESSIONS.
(This was derived from the sentence "Paul wanted the divorce, but he didn't want to see Sarah walk off with everything he had.")

Question 6: How did Paul feel when Richard called?
BORIS: PAUL WAS GRATEFUL BECAUSE
RICHARD AGREED TO BE PAUL'S
LAWYER.

(This was derived from the sentence "He (Paul) sounded extremely relieved and grateful," as well as some sentences indicating purpose and timing.)

Question 7: How did Richard feel when the coffee
spilled?

BORIS: RICHARD WAS EMBARRASSED.

(This was derived from sentences indicating that Paul was annoyed by Richard spilling coffee on him.)

BORIS's basic methodology is to create an AFFECT structure when an emotion word is discovered in a story. This AFFECT structure is combined with other semantic structures (namely GOALS, TAUs (Thematic Abstraction Units), ACEs (Affects as a Consequence of Empathy), and IPTs (Interpersonal Themes)) that help to explain the derivation of the emotion. These other semantic information structures are constructed for other understanding purposes beside emotion analysis. This is an important feature, because it allows BORIS to answer questions with regard to a particular emotion, even though no emotion word was specifically given in the story. BORIS does this by scanning these other structures to see if they might be able to imply the emotion in question.

One limiting factor of BORIS is that for an emotion to be detected, it must first be given to BORIS directly, either by the story or by the question. BORIS is not able to presuppose emotions on its own. Another limiting factor is that when BORIS does not have an AFFECT structure to imply an emotion asked about

in a question, it will not be able to find another semantic structure to imply the emotion unless such a structure was created as a reaction to an explicit mention of goal achievement or non-achievement in the story. BORIS knows nothing about the people in the story or about people in general, except what is explicitly mentioned.

Susan Ravlin, whom we will talk more about in the next section, has done some important work in goal evaluation for the purpose of emotion modeling. She explains that BORIS was not really intended to be a model of emotion, but rather that BORIS only “attempts to use affective cues in expectation-driven understanding” [Ravlin 1987]. This is consistent with our own assessment of BORIS. Ravlin gives the example that BORIS would be able to detect the emotions involved in the sentence “Joan Collins was **very annoyed** when Johnny Carson spilled a cup of coffee on her.” However, BORIS would not be able to find these emotions had the sentence been “Johnny Carson spilled a cup of coffee on Joan Collins, so she slapped him in the face.”

Despite these drawbacks, BORIS was able to account for more emotions than any other program written before it, and its representations took into account goals, prospects, and interpersonal relationships to explain the roots of emotions. BORIS could represent using AFFECT structures about 11 distinct emotions ranging from joy to guilt. For example BORIS’s AFFECT structure for Pride was:

(AFFECT
STATE (POS)
CHAR x
G-SITU (j)
TOWARD y)

This indicates that person x achieved the goal j of person y [Dyer 1983]. There are other factors that should be considered with the representation of pride, however, this representation goes far beyond what has been implemented in the past. We will discuss the other factors of pride in the description of our own model later on.

Foundations of our Cognitive Computer Model

Looking back over the four programs we have explored thus far, it is clear that none of them actually contained a true model of human emotion. ELIZA, though it mimicked a psychologist, had no understanding of the emotions of its patient. PARRY displayed emotionally induced acts and maintained a "mood," but the emotions PARRY "felt" were not motivated by the eliciting conditions of emotion, but rather direct links to "key words." ALDOUS exhibited an interplay of emotional representations, but knew nothing of the foundations of those emotions. BORIS finally delved into emotion foundations, but could not detect emotions that were not totally, or almost totally laid out in texts and questions. In addition, BORIS did not consider many of the important aspects and factors of the emotions it represented.

To go beyond these limitations, we have implemented a model that is based

on a well featured foundation of emotions that detects emotional situations, not just emotion words. This foundation comes from the work of Ortony, Clore and Collins [Ortony et al. 1988], Bouzid [Bouzid 1990], and Ravlin [Ravlin 1987]. Ortony's group developed the basic concepts of emotions our model is based on and expressed the theoretical construction of most of the emotions we have implemented on the computer. Bouzid refined the Ortony group foundation into one somewhat more suited for computer implementation and added the concepts of mood and disposition (as expounded upon by Ryle in [Ryle 1949]). Ravlin provided an invaluable example of a computer implementation of goal structures and repercussions of goal related events. This example served as a guide in setting up our own goal structure for use in modeling goal related emotions. Before continuing on to the chapters that describe our model, we should examine the contributions of these researchers here in more detail.

The Ortony group desired to construct a theoretical cognitive model that would spell out the conditions which elicit a comprehensive set of human emotions. They believed that this model could eventually be used by a computer to "predict and explain" the emotions of the people the computer was informed about. Consequently, they set out to describe emotions in concrete terms. Their first task was to explore the differences and similarities between emotions. By refining this exploration to smaller and smaller details, they were able to go a long ways toward this concrete explanation.

It occurred to them that on the most abstract level all emotions were focused

on the affected person's perception of events, agents and objects. Events can affect a person by achieving or inhibiting the person's goals. Joy and distress are linked to these kinds of events. Agents cause events to happen. Depending on whether the agent is oneself, or someone else, the emotions of pride, shame, admiration (which we will refer to later as approval) and reproach can be felt as a result of the agent causing an event. Objects are viewed by people with approval or disapproval. An object can be hated, liked or even loved.

While agent based emotions are limited to the four mentioned above, and object based emotions can be (perhaps over-simply) described as degrees of liking and disliking, event base emotions still require further breaking down and delineation. As we said before, events can cause a person's goals to be inhibited or achieved, causing distress or joy, but it is also true that events could cause someone else's goals to be inhibited or achieved. This gives rise to the emotions of feeling sorry or happy for another person. A further complication arises when we consider that the affected person may not like the other person experiencing the event. If this is the case and the other person has achieved a goal, then the affected person may feel resentment. On the other hand, if the other person's goal was inhibited, then the affected person may gloat.

So far we have only considered feelings toward current events, but what about events in the future? The Ortony group refer to these future events as "prospective events," and the emotions caused by them are called

“prospective emotions.” A person could fear a future event that could cause goal inhibition, or hope for a future event that could cause goal achievement. What happens when one of these prospective events actually happens? If a hoped for event comes true, then satisfaction is felt. If a feared event comes true, then a sinking feeling of fears-confirmed is felt. These two emotions are called “confirmation emotions.” If a hoped for event does not come true, then disappointment is felt. If a feared event does not come true, then relief is felt. These last two emotions are called “disconfirmation emotions.”

Looking back over this taxonomy of emotions, the Ortony group has identified eighteen emotions: Joy, Distress, Sorry-For, Happy-For, Resentment, Gloating, Fear, Hope, Satisfaction, Fears-Confirmed, Disappointment, Relief, Admiration, Reproach, Pride, Shame, Liking and Disliking. Using some of the event based and agent based emotions, they go on to identify four more “compound emotions,” namely Gratitude (caused by Admiration and Joy), Anger (caused by Reproach and Distress), Gratification (caused by Pride and Joy) and Remorse (caused by Shame and Distress). (As a matter of reference, we will refer later to Gratification as Self-Satisfaction because we feel there is more intuitive identification with term “self-satisfaction” and this emotion. We will also refer to Admiration as Approval for the same reason.)

Once these basic delineations of emotions were made, the Ortony group went on to their second task which was to define all the factors (or “parameters”) that effect these emotions. Certainly all of the above constraints are among these factors, but they are by no means exhaustive. Consider the likelihood of

events in conjunction with prospective emotions, the deservingness of others in conjunction with Happy-For and Sorry-For, the blameworthiness of agents in conjunction with Shame and Reproach, and the degree in which we are familiar with the objects we feel emotions toward. All these factors and many more influence our emotions, and must be considered, especially in the evaluation of emotional intensity or degree. Instead of going through all of them here, however, we will examine each one, together with their implementational details, in chapters 5, 6 and 7.

One important feature of emotion that the Ortony group did not explore is that of the temporal aspect of emotional states. They expressed a vague notion that some emotions seem to last longer than others, but they did not provide adequate support for this idea. Bouzid looked to Ryle [Ryle 1949] to put a more temporal flavor into the model. Ryle broke the timing of emotions into two groups: *emotional episodes* and *emotional dispositions*. Emotional episodes represent our immediate emotional reaction to that which we experience. Dispositions are the background emotional states that we carry with us and which may color our immediate emotional reactions. Bouzid broke Ryle's notion of disposition into two parts. The first part he calls *mood*. Moods are emotions that last for some period of time and then die out. As a result of elapsed time, the mind stops focusing on the cause of the mood. Bouzid's calls the second part *disposition*. Dispositions are persistent emotional states that do not die out as a function of time. For example, our having a disposition of disliking for blueberries implies that we will continue to dislike blueberries until our opinion of them is directly

modified, perhaps by tasting blueberries later and finding that they are not as bad as we thought. We will lose our dislike blueberries simply as a result of the passage time. We have further ironed out these distinctions and have implemented them in our computational model. They will be discussed in more detail in Chapter 4.

In the detection of event based emotions, as we have indicated before, it is critical to maintain a structure of goals held by each agent. The interplay of events and goals is the primary motivation for event based emotions. Knowing that goals would be important to any computational emotion model, Susan Ravlin, a graduate student of Ortony's, developed a program to model a structure of goals and determine the positive or negative affect produced by achievement and inhibition of these goals [Ravlin 1987]. Her classic test case is of a person aspiring to become a concert pianist. Figure 1 shows her goal structure for this scenario.

Each box in the hierarchy represents a goal. Goals underneath other goals are subgoals. If a subgoal is achieved, there is a probability that the supergoal will also be achieved. This probability is expressed in the link between the supergoal and the subgoal. For example, looking at the hierarchy, there is a very high chance that getting a debut with Vladimir Horowitz will result in getting an agent. This method of organizing goals was used in our own modeling of the goals inherent in patients and doctors for the test case scenario discussed in Chapter 10. Another important feature of Ravlin's program was how it evaluated the importance of goals based on their ability

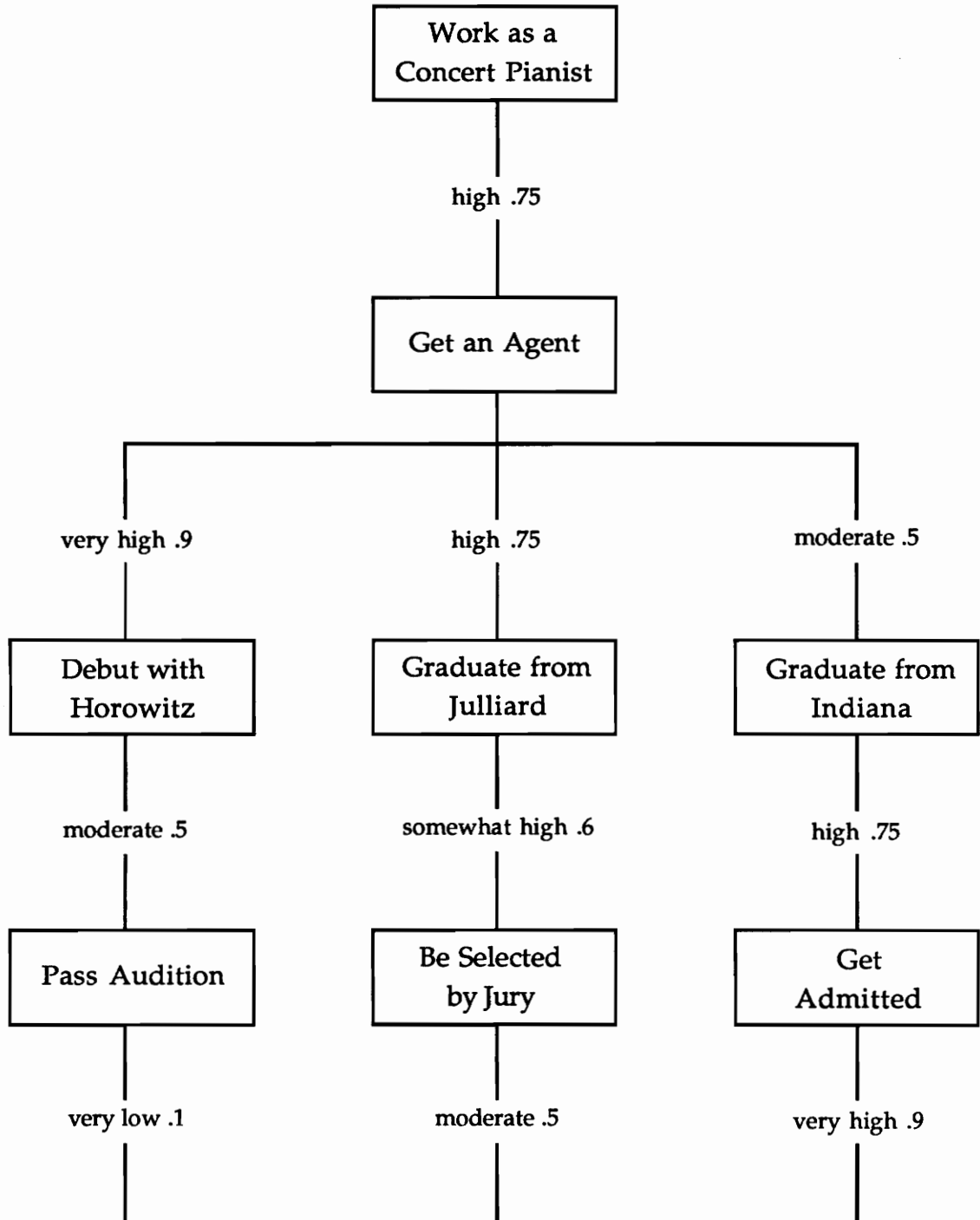


Figure 1: Ravlin's Goal Structure for an Aspiring Pianist

to achieve supergoals. This notion implies that being selected by a jury, for example, is more desirable than getting admitted to the Indiana University School of Music, because the jury route has a higher combined chance of achieving the goal of getting an agent (.45 vs. .375). Adopting this method of determining goal importance helped us to ascertain the degree of emotional intensity exhibited toward events.

Throughout this paper, we will refer to the influences that the Ortony group, Bouzid and Ravlin have had on the individual components of our computational model. In many cases, the specifics of their ideas had to be modified, added upon, or reduced in order to produce a fully defined, yet readily attainable implementation. Despite these changes, we have tried to remain true to their general concepts throughout the computational model.

3. A Computational Solution to Modeling Emotions

When we set out originally to build our model, the first question that came up was: “Which emotions are we going to include?” The Ortony group defined a total of twenty-two emotions (including compound emotions), but are these really comprehensive? To answer this question, we explored a list of about 250 emotion terms that were cataloged in [Bouzid 1990] and compared these terms with the twenty-two emotions defined by the Ortony group. Bouzid had also made this comparison in his thesis, but arrived at a different conclusion than we have. The overwhelming majority of the terms were simply synonymous to the Ortony group emotions. Many indicated specific degrees of an emotion, for example “hate” as high disliking or “terror” as high fear. Bouzid concluded that all the 250 terms were in fact represented by the Ortony group emotions. We concluded that seven new emotions are needed to completely cover the 250 terms. These new emotions are: Desire, Despair, Aspiration, Dread, Spite, Humiliation, and Coveting. All of these emotions can be easily described, mostly using the constraint factors already provided by the Ortony group. One of them, Humiliation, we decided is too complex to model effectively in our system. We did implement the other six, and they are described in Chapter 9.

Now it is true that what we really want to model is the set of emotions that

people feel, not the emotion words that people use to describe them. However, it is also true that examining a set of emotion words that point to a set of emotions is useful in determining the set of emotions. This is not conclusive, of course. A language may have a very limited ability to explain true emotions. Fortunately, the language expressing the 250 emotion terms, namely English, is quite extensive, and seems competent in describing a comprehensive spectrum of emotions. Defining a set of emotions that people feel is a subjective business. The fact that 250 terms point collectively to the emotions we chose, simply adds inductive validity to our subjective choices.

It is interesting to note that Dyer, in his quest for defining his own set of emotions, also considered a list of emotion terms. This list was defined by Davitz [Davitz 1969], and included 400 emotion words which Davitz mapped down to 50 unique affect-related terms. This set was then reduced to 11 emotions by Dyer. While we believe that some of Davitz's terms were not "unique" enough to distinguish in our model, such as "Sadness" and "Depression" or "Gaiety" and "Delight," we also believe that Dyer's reduction generalized too far. For example, Dyer put being happy for oneself and being happy for someone else in the same emotional representation as just being happy. Dyer also made no distinction between pride in oneself and approval towards others.

Detecting Emotions

Once we decided which emotions to model, we turned to the question of how

our model would go about detecting these emotions. For a program to detect the Ortony group emotions and the extra emotions we added, it must understand these emotions, that is, it must know what conditions elicit emotions, and it must be able to recognize these conditions when they occur in a contextual scenario. These conditions embody the cognitive process that cause a person to exhibit an emotion. For example, when we believe something good has happened to us, this condition causes us to feel joy. When something good happens to someone we do not like, this condition causes us to feel resentment. Note that defining emotion understanding in terms of eliciting conditions is much different than going after “key words” in a conversation.

To implement this concept of conditions eliciting emotions, we programmed “emotion detectors.” Each of these detectors is responsible for determining if all of the conditions for a given emotion have been satisfied. Each condition within a detector is represented as a “constraint.” These constraints define each condition in concrete terms that a computer can utilize. For example, the condition “something good happened” is represented in constraint form as “event x caused goal y to be achieved to a z degree.” Neither Ortony nor Bouzid expressed fully concrete definitions of constraints that could be implemented on a computer. Each one had to be meticulously defined before implementation. Often the definitions had to be reevaluated and revised. Many of them required quite complicated computational maneuvers. The details of these constraints are reported in chapters 5, 6 and 7.

Model Architecture

To organize these emotion detectors within our system we first looked at the “software engine” technique that is so prevalent in expert system design. Bouzid proposed this method and wrote of implementing five engines to divide up the task of emotion detection. These theoretical engines were called the “Verbal Expressions Evaluator,” the “Goals Evaluator,” the “Norms Evaluator,” the “Tastes Evaluator,” and the “Emotions Parser.” The first four engines were “middle-man” engines that discerned which constraints were satisfied by the current context. The Emotions Parser could then utilize this knowledge to detect emotions. Bouzid’s theoretical model layout is shown in Figure 2.

The Verbal Expressions Evaluator came primarily out of Bouzid’s desire to find the emotions indicated by verbal formulations. For example, if John said, “wasn’t *that* an interesting way of acting...” then this engine would be able to detect that John was being sarcastic and that John believed that someone acted in a blameworthy fashion, thus eliciting reproach from John. The Verbal Expressions Evaluation even went so far as to consider such curious pragmatic issues as Freudian Slips. We felt that this was going beyond the sophistication we intended to achieve in the scope of our model and thus did not implement any analog of this engine in our own system. We did, however, implement the substance of the other four engines, although not with quite the same design. Bouzid’s “Goal based emotions,” “Norm based emotions,” and “Taste based emotions” are equivalent to our

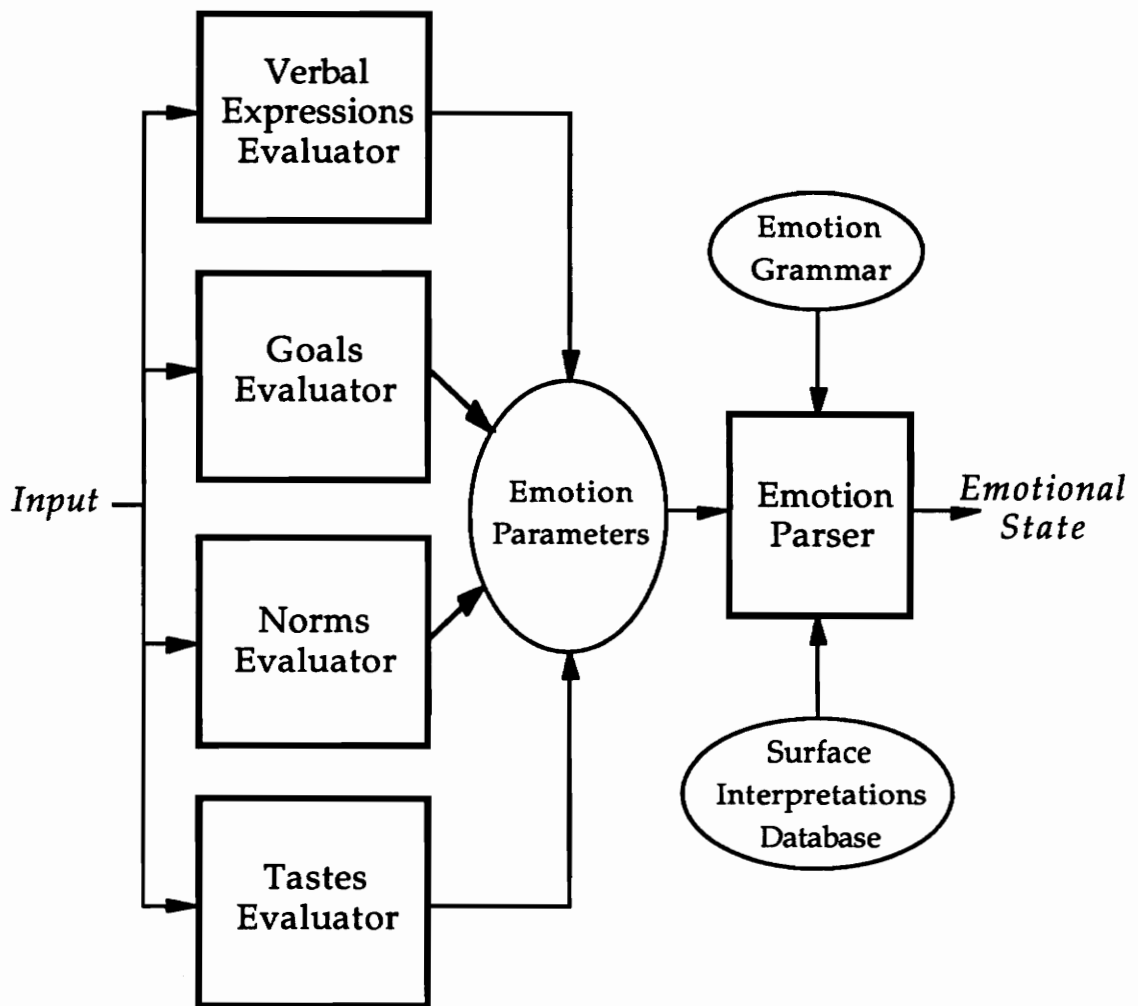


Figure 2: Bouzid's Theoretical Functional Model Layout

notions of event based emotions, agent based emotions, and object based emotions, respectively. The job of Bouzid's Goal Evaluator was to generate the set of event based emotional constraints satisfied by the current context. For example, the constraint of "John's goal was inhibited," which is used to deduce the emotion DISTRESS is satisfied by the contextual act of "The policeman threw John in jail."

The job of the Norms Evaluator was to find the constraints satisfied for agent based emotions, and the job of the Tastes Evaluator was to find the constraints satisfied for the object based emotions. In theory, once the Evaluators generated the constraints satisfied, the Emotion Parser would put them together and form the emotional states, including the emotional episodes, moods and dispositions, as well as the compound emotions. Bouzid also indicated two main data collections. The Emotions Grammar data collection would indicate the particular emotions generally applicable in any given context, and thus reduce the search space for the Emotion Parser. The Surface Interpretations Database indicated the immediate emotional implications of specific words.

The structure we eventually adopted for our model differs from Bouzid's in two important ways. The first is that at the top level, we have broken the emotional state down into its three temporal dimensions of episode, mood, and disposition, and then constructed engines to generate emotions at each of these dimensions. The second difference is that our engines derive the constraints of emotions directly, rather than by going through "middle-man"

engines. The architecture of our model system is shown in Figure 3.

The Episode Engine generates original emotions in the focus dimensions of events, agents and objects, and thus it is broken down into three internal engines to deal with these dimensions. The Mood Engine and the Disposition Engine consider already existing emotions and their interactions with new emotions generated by the Episode Engine. Consequently, the need to break these later engines down into smaller engines was not considered necessary. Compound emotions are handled separately by the Compound Engine. In addition to the act input to the model, there are also two main databases that provide information to the engines. The Act Indicators database provides some low-level interpretations about acts, and the Agent Characteristics database provides some information on the scenario participants.

The dashed lines in Figure 3 indicate that the output of the engines is often fed back into the system. More specifically, the Episode Engine must keep track of past emotional episodes to model confirmation and disconfirmation emotions. For example, to detect relief in an agent's present emotional state, the Episode Engine must know that fear was detected in the past. The Mood Engine must know the past mood in order to preserve the old mood until a new more powerful mood comes along, or until the old mood dies out. Dispositions are one characteristic of agents. In the event that a change in disposition occurs, the Agent Characteristics database must be notified. These instances of passing back information help to keep the system up to date as

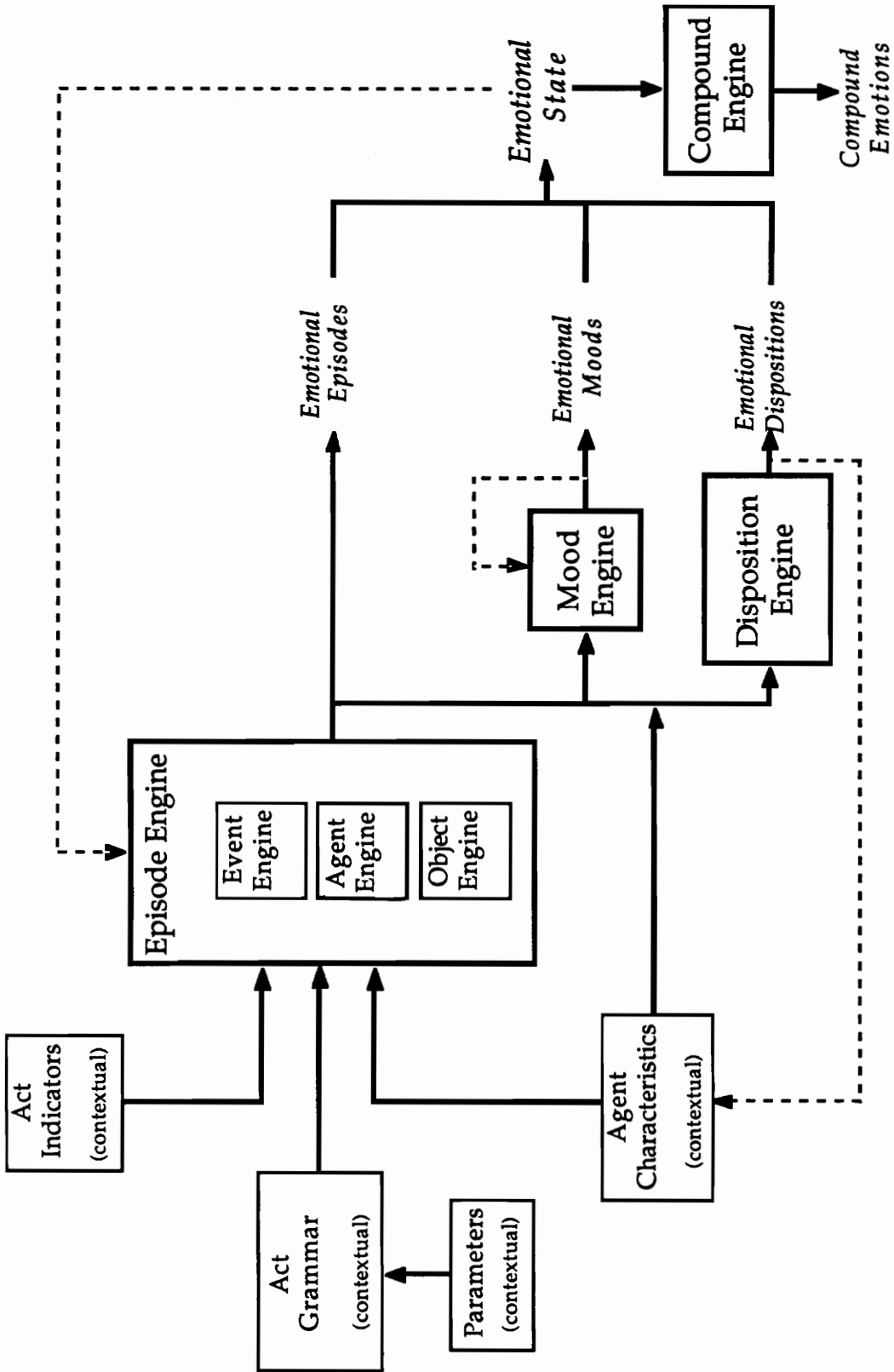


Figure 3: Functional Layout of Our Model

the context evolves.

Also in Figure 3, some components of the model are marked “contextual,” while others are not. The contextual marking indicates that the component includes information specific to the test input scenario. From the start we wanted to make a clear separation between what was general in our model and what was specifically geared to a context. Note that none of the engines have contextual information in them. This supports the assertion that emotion detection in our model is not domain specific.

Input and Output

Once we determined the construction and layout of our emotion detectors, we went on to the the task of determining just how the input to the model and the output from the model should be manifested. On a high abstract level, we knew that a context (such as a patient meeting with a doctor) should be the input and the output should report the emotional states of the contextual participants. On an implementation level, we now had to determine how this context would be communicated to the model and how emotional states would be expressed by the model.

We explored the possibility of actually parsing text, as BORIS did. The problem with adopting this form of input is that it would require great amounts of processing that has nothing to do with the understanding of emotions. We knew that just giving emotions adequate attention would take

a great effort, so to sidestep the parsing issues, we opted for a more intermediate form of input to our system. Instead of using English texts as input and discerning the implied acts involving emotional events, agents and objects through parsing, we decided to use a representation of acts directly as input. Consider having to parse the sentence "The competent doctor, after the examination, decided to prescribe the antibiotic penicillin to combat the patient's throat infection." A general text parser must break this down into representations indicating the acts of 1) The doctor examining the patient, 2) The doctor concluding that the patient has a throat infection, and 3) The doctor prescribing penicillin. Such a parser has to understand word senses, conjunctions, references, tenses, and a great number of other issues. All our model wants, however, is the acts, so we input directly "(Doctor ExaminePatient ())", "(Doctor DetectIllnessOf (throat_infection))" and "(Doctor PrescribeMedication (penicillin))." This allows us to focus on just the emotion issues and avoid the parsing issues. Certainly, a parser could be built to map sentences to our act structures, so in the long run, this is not a drawback. A complete explanation of acts and how they are injected into the model is provided in Chapter 10.

After determining the input to our system, we set our attention on the output of our system. Given the input, we must provide the immediate (or "episodic") emotional reaction to the events, agents and objects focused upon in the act, any emotional dispositions relevant to the foci, and finally the emotional mood. The dispositions and moods also break down into event, agent and object focused emotions. This information must be provided for

the state of each person involved in the act scenario (i.e., the actor (or “agent”), and those whom experienced the act.) In addition to the nine emotions connected with the state, combinations of basic emotions may imply compound emotions that need to be expressed. Considering all this, it is obvious that just putting out some message saying “John is happy” is not at all sufficient to express John’s complete emotional condition.

To summarize our final emotional output state format, we will show 1) the event episode, 2) the agent episode, 3) the object episode, 4) the episode compound emotion, 5) the event mood, 6) the agent mood, 7) the object mood, 8) the mood compound emotion, 9) the event disposition, 10) the agent disposition, 11) the object disposition, 12) the object compound emotion, and 13) the compound emotions between episodes and dispositions. Never, or at least extremely rarely, will emotions be detected in all 13 of these output areas for one act. Our model’s output format is capable, however, of showing all these 13 for any given act.

In addition to the primary output of emotional states, we also decided that we could make our model more robust by providing the user with a complete analysis of how the model deduced the emotions indicated in the emotion state. It is one thing to say “John is happy,” it is quite another to say *why* John is happy. We thought it would also be helpful if this analysis expressed not only why emotions appeared in the state, but also why other emotions were not present. Through this analysis, our system can be “held accountable,” so to speak.

The final model, including all of the components mentioned above, was written on a VAX 8600 computer at Virginia Tech, in PROLOG. PROLOG was particularly well suited to our problem thanks to its facts and rules structures. PROLOG allowed us to “prove” emotions as supported by constraints. The model itself, that is, all the components that are not marked “contextual” in Figure 3 took up 237 kilobytes of memory. The contextual components took up 217 kilobytes, making the complete system 454 kilobytes. On the following page, the number of lines of code written to implement each component is shown.

Table 1. Size of each System Component in terms of Lines of Code

<u>System Component</u>	<u>Lines of Code</u>
Act Grammar Specification*	1,815 lines
Parameters Database*	75 lines
Input Processing Support Code	1,635 lines
Act Indicators Database*	5,441 lines
Agent Characteristics Database*	392 lines
Episode Engine (non incl. subengines)	223 lines
Event Engine	1,699 lines
Agent Engine	401 lines
Object Engine	191 lines
Mood Engine	428 lines
Disposition Engine	866 lines
Compound Engine	50 lines

	Total: 13,216 lines

(* indicates that the component is contextual)

4. The Focus of Emotions

As we mentioned in Chapter 2, a critical defining feature of emotions is the focus of emotions. This was the Ortony group's highest level distinction between emotions. The question of how to extract the foci from acts was of extreme importance in the development of our model. Given an act, what events, agents and objects would be considered by the scenario participants? This chapter explains how we implemented the answer to this question.

Events

Initially, it is obvious that each act in itself is an event. An event can be defined as "something that happens in time." Clearly, an act is something that happens in time. It is also true that such an act is an event not only to the actor, but also the other scenario participants perceiving the act. This notion was very easy to implement, of course, and seemed to work quite well until prospective emotions came into play. Consider the following output: "The Patient feels HOPE associated with the event (Doctor PrescribesMedication (penicillin))." This seems quite curious because the event in question seems to be an immediate one, rather than a prospective one. Why would the patient be feeling hope, rather than joy or some other non-prospective emotion?

The answer to this question is that in addition to the physical event of the act itself, there is also a mental (or “cognitive”) event associated with the act. The patient is looking forward to finding that the medication is effective in curing his or her affliction. This later event would, in turn, achieve the patient’s goal of being free of illness. If we say, “The Patient feels HOPE toward the goal of BeingFreeOfIllness as a result of this act,” it makes much more sense.

There is another reason why it makes sense to add the cognitive goal as well as the act within an event focus, besides the fact that it makes more sense in explaining output. This reason has to do with confirmation and disconfirmation emotions. When a prospective emotion occurs, that is, an emotion of hope, fear or some other related emotion, the cognitive focus is directed towards some future achievement or inhibition of a goal. Later, when this goal is achieved or inhibited, the emotional state changes to satisfaction, disappointment, or some other confirmation/disconfirmation emotion. In order for the model to detect these emotions, it must look at the cognitive aspect of the events focused on in the past to discover that the goal currently achieved or inhibited was previously considered.

Let us clarify at this point a question that may have arisen concerning emotions being focused on future goals rather than physical events. We say the future focus is a goal rather than a physical event because when an associated confirmation or disconfirmation emotion occurs, it does so regardless of which specific future event effected the goal in question. For

example, if we feel hope towards becoming a concert pianist, it does not matter if the event of playing at Carnegie Hall or being hired by the London Philharmonic achieves this goal. Satisfaction is felt regardless.

So with these considerations in mind, we define an event associated with an act as being both the act itself and the goal considered cognitively by the person perceiving the act. Note that this means that given the same act, each person perceiving the act may see the event differently, as dictated by his or her own goals.

Agents

As with events, there is an immediate intuitive mapping of acts to agents. This mapping simply implies that anyone who performed the act is the agent of the act. This goes a long way toward defining the agent focus, but predictably falls short of attaining the complete picture. We must take two special considerations into account before we can achieve truly effective act to agent mapping.

The first consideration is that the objects of acts may also cause some event, or in other words, an object may be the agent of an event. For example, consider the act, “(Patient DeclaresEffectOfMedication (beneficial)).” While it is true that the patient is the agent of the statement, it is also true that the medication, perhaps penicillin specifically, is the agent of making the patient feel less ill. When the patient makes this statement, it may indicate that he or

she is feeling approval (an agent based emotion) towards penicillin.

The second consideration is that there are times when a person feels that his or her acts are directly precipitated by the acts of others. For example, when a patient thanks a doctor, the patient feels that the doctor's acts have earned his or her gratitude. The patient may focus on him or her self as the agent of expressing the gratitude, and thus may feel pride as a result. But more directly, the patient will consider the doctor as the cause of his or her thanks and feel approval towards the doctor. This implies that there are times when other scenario participants must be considered as agents, in addition to the primary actor.

So in retrospect, an agent is a person or an object, and there may be more than one agent focused on with respect to a given act. It is also true that each scenario participant may focus on different agents. For example, if a doctor gives a patient medicine that fails, the doctor may focus on the medicine as a failure, but the patient may focus on the doctor as being responsible for prescribing bad medicine.

Objects

Extracting the object focus from an act is fairly simple. The basic syntax of our acts, as demonstrated by previous examples, is “(<actor> <act> (<act parameter>)).” The act parameter is often the object of focus. For example, in the act “(Doctor PerformsTest (EKG)),” the EKG test is clearly the object in

focus. There are times when the actor is the object, for example, in the act “(Doctor KicksPatientOut ()),” the patient considers the doctor as an object. Note also that the objects focused on by one participant may be different from those focused on by another. In the last example, the doctor focused on the patient as an object, rather than himself. Each of these participants may focus on themselves as well.

The specification of events, agents and objects is done within the Act Indicators database. The Event Engine also adds goal information to the event in focus, if any such goal applies. The relations (or “predicates” in PROLOG) expressing these three focus classes are “(EventTo <person> <act> <event>),” “(AgentTo <person> <act> <agent>),” and “(ObjectTo <person> <act> <object>).” For any given act, these relations are expressed multiple times to show all the applicable focus mappings considered by each scenario participant.

5. The Constraints of Event Based Emotions

In our Event Engine, there is a collection of emotion detectors, one for each event based emotion. The detector for a given emotion will signal that the emotion is currently being felt if its particular set of constraints is satisfied. For example, the joy detector will report joy if its constraint of determining someone's goal achievement is met. There are constraints that help indicate the intensity of the emotion as well. For instance, the joy detector has an additional constraint that expresses the "desirableness" of the goal achieved (that is, how much the goal is desired.) The more desirable the goal is, the more intense the feeling of joy will be. Some constraints are mandatory for a given emotion to be felt, while others may be optional, and simply add to the understanding of the emotion. In this chapter, we will examine in detail the event based constraints used to support the assertions of event based emotions in our model. How these constraints are combined in useful defining sets for each emotion detector will be discussed in Chapter 9.

Achievement and Inhibition of Goals

When an event occurs, it is of primary importance to discover if the event has caused a person's goal to be achieved or inhibited. This is the most crucial constraint for detection of event based emotions. Within the Act Indicators

database, for each act we specify an “EventToGoalLink” relation if the act inhibits or achieves some goal. Because the goals of each person are different, we must specify in this relation just whose goal is being referred to in addition to the goal itself. The syntax for this relation is “(EventToGoalLink <person> <act> <goal> <nature of link>).” The “nature of link” part of the relation is a number between -5 and +5. If the number is positive then the act is causing the goal to be achieved to some degree. On the other hand, if the number is negative, the act is causing the goal to be inhibited to some degree. This notion of degree is important because life is not black and white; often we only partly succeed or partly fail. When we consider the intensity of an emotion, this degree must be taken into account.

The direct emotion detector constraint relation of “(EventAchievedGoal <person> <event> <goal> <degree>)” is satisfied if a positive EventToGoalLink is detected for the act in question. The same is true for the “(EventInhibitedGoal <person> <event> <goal> <degree>)” relation, only with a negative EventToGoalLink. For emotions directed towards oneself, such as joy or distress, the person indicated in these relations is the self. For emotions concerning others such as sorry-for and happy-for, the person is someone other than the self.

Desirableness of Goals

Once a goal is detected with one of the constraints mentioned in the last section, it is important to know how desirable the goal is in order to evaluate

the intensity of an emotion. It was Susan Ravlin's method [Ravlin 1987] of calculating this goal desirableness that we adopted for our model. We constructed goal hierarchies for our scenario participants similar to the one shown in Figure 1. This was done with the "(GoalToGoalLink <supergoal> <subgoal> <probability>)" relation. The "probability" part indicates the probability that the achievement of the subgoal will also cause the achievement of the supergoal.

Once the hierarchy was set up, we used Ravlin's idea that the desirableness of a given goal in the hierarchy is equal to its probability of eventually causing the achievement of the root goal. For example, if the achievement of the goal in question has a .5 probability of causing its supergoal to be achieved, and its supergoal has in turn a .6 probability of causing the root goal to be achieved, then the desirableness of the goal is .3 (i.e., $.5 \times .6$). This makes for a very effective way of discerning goal desirableness because it utilizes the hierarchy's natural ability to denote the importance of all our little goals in relation to our big goals (or "root goals").

For our model, all degrees are reported on a scale of 1 to 5 (for low, medium-low, medium, medium-high, and high respectively.) To accommodate this, the probabilities had to be converted to a 1 to 5 scale from the percent scale. We felt that percents were really indicating a finer degree of granularity than is significant for the expression of degree.

By this method, we implemented the direct emotion detector constraint

relation of “(DesirablenessOfGoal <person> <goal> <degree>)” by querying a subconstraint that constructs a path between the given goal and the root goal. This “GoalPath” subconstraint also calculates a product for the probabilities along the path. Again, note that the person has to be referenced in the constraint so as to indicate whose goal hierarchy is to be scanned.

Possible Future Goal Achievement or Inhibition

The constraint of “(PossibleFutureGoalAchievement <person> <current_event> <future_event> <goal> <degree_of_achievement>)” and its corresponding constraint for possible future goal inhibition are needed to detect the occurrence of prospect emotions such as hope and fear. Given the person and the current event, these constraints search the Act Indicators Database for an indication that the current event will cause the person to look towards a future event, and this future event will in turn either inhibit or achieve some goal. The future event, the goal, and the degree to which the future event will achieve or inhibit the goal are provided to the detector by the constraint that discerns the inhibition or achievement of the goal.

Within the Act Indicators database there are “EventToEventLink” relations that express the current event to future event implication. Once one of these is found by one of the constraints mentioned above, it then looks for an “EventToGoalLink” relation, given the future event as input. If such a relation is found, and the link is of a positive nature, then the “PossibleFutureGoalAchievement” constraint succeeds. If the link is of a

negative nature, then the “PossibleFutureGoalInhibition” constraint succeeds.

Note that there may be more than one “EventToEventLink” for a given person and a given act. This fact may cause more than one goal to be in focus. It is even possible that a given prospective event may both inhibit one goal and achieve another at the same time. For example, if the doctor suggests surgery to the patient, the patient will look towards the possible goal achievement of being cured, but also at the same time, he or she may look towards the goal inhibition of avoiding pain and a long hospital stay.

Goal Links to Previous Emotions

In detecting confirmation and disconfirmation emotions, it is necessary to discover if a prospective emotion was felt in the past. It must also be the case that the goal focus of the prospective emotion was the same as the goal in question for the current emotion. In order to detect this, we implemented a “(GoalLinkToPreviousEmotion <person> <emotion> <goal> <degree_of_emotion>)” relation.

This relation scans through all the previous emotional states of the person in question, looking for the given prospective emotion. If it finds such an emotion, and the goal indicated by the emotion detector is the same as the past emotional goal, then the GoalLinkToPreviousEmotion constraint succeeds. The constraint also provides the detector with the intensity (or

“degree”) of the prospective emotion so that it can be factored into the degree of the confirmation or disconfirmation emotion.

An example of this constraint in action is as follows: A patient finds that the medication he or she has been taking is not curing his or her illness. In terms of the model, this event has caused the inhibition of a goal. The disconfirmation emotion detector in charge of disappointment will use the GoalLinkToPreviousEmotion constraint to discover that the patient had previously hoped for the medicine to succeed. As a result, the detector is able to report that disappointment is evident. The degree of disappointment is partly based on how strong the patient’s hope was.

It is interesting to relate that such constraints as the likelihood of the prospective event being achieved are indirectly considered by the disappointment detector, since the likelihood helped to determine the degree of hope associated with the disappointment. For example, if the patient did not think it was very likely that the medication would work, and consequently the patient’s hope was low, then the patient’s disappointment would also be correspondingly low. The likelihood of events is a very important constraint in the consideration of emotion intensity, and its implementation is described in the next section.

Likelihood of Future Events Occurring

The likelihood of the occurrence of a prospective event is of critical

importance when considering despair or dread. Despair occurs when there is no likelihood of a hoped for prospect coming to pass. Dread occurs when the likelihood of a feared prospect is absolute. When we consider the intensity of hope, fear and aspiration, the likelihood of the involved prospect must also be considered. As we saw in the last section, this likelihood factor also considered indirectly by the confirmation and disconfirmation emotions.

In the section describing the possibility of future goal achievement or inhibition, we mentioned the use of the subconstraint “EventToEventLink” as part of the future goal effect detection process. The full syntax of this relation is “(EventToEventLink <person> <past_event> <future_event> <likelihood_booster> <realization_booster> <prevention_booster>).” The later two “boosters” pertain to the constraints discussed in the next section; however, the “likelihood booster” is the critical data indicator used to assess the likelihood of the future event in question.

The reason we use the term “likelihood booster” because it indicates the increase (or sometimes the decrease) of the likelihood of the future event occurring, given this particular event. This booster may be positive or negative. To understand how this works, consider a scenario of a student looking towards the event of passing his or her final exam. When the student passes the first midterm, the likelihood of passing the final exam is boosted. Later, however, the student failed the second exam, so the perceived likelihood of passing the final exam is reduced. This reduction is represented by a negative boost. Because of this fluctuating likelihood, the degree of hope

felt by the student also fluctuates as time goes by.

This last assertion implies that the likelihood constraint must look at all the applicable “EventToEventLink” relations connected to a particular goal in order to arrive at a conclusion of overall likelihood at any given point in time. As a result, we define the “(LikelihoodOfFutureEventOccuring <person> <current_event> <future_event> <likelihood>)” constraint as an indicator of this collective likelihood viewpoint. The first EventToEventLink likelihood booster determines the base likelihood, and this base then fluctuates with each additional booster discovered.

Effort to Realize or Prevent Events

The effort to realize or prevent an event is important to consider when evaluating the intensity of confirmation or disconfirmation emotions. For example, the more effort a person has expended to realize a hoped for prospect, the more satisfaction that person will feel when the prospect comes to fruition. Correspondingly, the more effort a person has expended to prevent a feared prospect, the more relief the person will feel when the prospect is evaded.

The “(EffortToRealizeProspect <person> <event> <degree_of_effort>)” constraint and its companion “EffortToPreventProspect” are implemented in much the same way as the likelihood constraint discussed in the last section. Recall that the EventToEventLink relation specifies a “realization booster”

and a “prevention booster” in addition to the likelihood booster. Like the likelihood booster, these effort boosters can be compared over a series of past events in order to obtain overall effort expended towards a given goal at any particular time.

Deservingness and Undeservingness

The constraints of deservingness and undeservingness are used to consider the intensity of emotions directed towards the fate of others such as sorry-for, happy-for, and resentment. For example, the happy-for intensity is enhanced by deservingness of the other’s goal achievement. These constraints were perhaps the most poorly described by the Ortony group. The Ortony group did not provide “how to implement” details for any of the constraints, and these two constraints were no exception. How do people really evaluate deservingness? The problem is very philosophical in nature.

Our solution to the problem was a fairly simplistic one, based mainly on the concept of “an eye for an eye” justice. Our assertion is that if an event involves a person doing something rotten to someone else, then the person “deserves” to have the same rotten thing done unto him or her. Conversely, if someone does something nice for someone else then that someone deserves nice things to happen to him or her. We implemented this notion with the relation “(EventJusticeLink <person> <other_person> <event> <future_event> <justice_booster>).” It was important to specify the person asserting the link as well as the person accused by the link. When one person

feels another deserves some event to happen to him or her, the other person may not agree with this opinion.

When considering whether or not a person deserves the given event, our “(FeelsDeservingOf <person> <other_person> <event> <degree_of_deserving>)” constraint first searches for any EventJusticeLinks that pertain to the event in question. If such links are found, then the justice boosters of the links are added up. If the sum is positive, then the constraint succeeds and the sum is reflected in the degree of deserving. The FeelsUndeservingOf constraint works in a similar way except that the sum must be negative.

Actually, these constraints will succeed even if no EventJusticeLinks are found. The foundation for this assertion is that, generally speaking, if we know of no specific reason why somebody is deserving, then by default, we feel that people deserve good things to happen to them and do not deserve bad things to happen to them. If no EventJusticeLink is found and the event is causing someone else’s distress, the FeelsDeservingOf constraint succeeds, but reports the degree of deserving is zero. Conversely, if the event is causing someone else’s joy, then the deserving is reported as normal, or medium. (For high deserving, we maintain that this has to be specifically earned.) The opposite of these assertions holds true for the FeelsUndeservingOf constraint.

Elevation of Status

The elevation of status constraint was not an Ortony group constraint. We

developed it on our own to support the emotion of aspiration. Aspiration is like hope except that it holds the future is one that will cause the affected person to gain prestige, rank or fame. We implemented the “(GoalImpliesElevationOf <person> <goal> <degree_of_elevation>)” constraint to support this concept. It simply looks to see if the goal in question is tagged to have a positive elevation value. Many of our goals in daily life are indirectly tied to elevation of status. For this constraint, however, we are attempting to identify goals that are directly tied to status elevation. For example, getting a master’s degree is directly tied to status elevation, while getting a good grade on a term paper in a class in the master’s degree program is indirectly tied to status elevation.

6. The Constraints of Agent Based Emotions

Like the Event Engine, the Agent Engine has emotion detectors - four to be exact, one for pride, shame, reproach, and approval. These detectors also have constraints that indicate the presence of an emotion and imply its intensity. All of these agent based constraints indicate how one person evaluates his or her own actions and the actions of others.

Praiseworthiness and Blameworthiness

How we judge the conduct of others and ourselves depends on our expectations of good behavior. Our expectations, or “norms,” imply which actions we perceive as praiseworthy and which actions we perceive as blameworthy. Actions that violate expectations are blameworthy and lead to shame and reproach. Actions that meet or exceed expectations are praiseworthy and lead to pride and approval. We have implemented these constraints of blameworthiness and praiseworthiness in terms of three types of expectations defined by Bouzid [Bouzid 1990], namely, 1) obligatory norms, 2) optional norms, and 3) normally expected norms or common norms.

Obligatory norms indicate actions that we must do in society. For example, we must pay our debts. To conform to such norms is not considered to be

particularly praiseworthy; they are simply the requirements of our society. When we do not abide by them, it is considered to be highly blameworthy. For example, we are not praised for refraining from the act of murder, yet if we do commit a murder, we are considered to be terribly reprehensible.

Optional norms denote actions that we should do, but are not so obliged to do (as in the case of obligatory norms). Donating to charity is an example of such an act. When we perform an optional norm act, we often receive considerable praise; however, when we do not perform such an act, it is not really considered blameworthy.

Common norms indicate generally rather trifling actions that we are expected to do, such as wearing tasteful clothing or paying attention to someone when they are talking to us. Conforming to such norms may bring us a little praise. Not conforming to them may bring us a little blame.

Considering these three norm types, there are seven possible act interpretations. First of all we could perceive an act as non-norm sensitive, like sitting in a chair. The other six are the conformance and non-conformance of the three norm types. Of these seven interpretations, only four imply that someone has done something praiseworthy or blameworthy. We disqualify non-norm sensitive acts (obviously), the conformance to obligatory norms, and the non-conformance of optional norms.

To implement the remaining four norm interpretations, we constructed the

relation “(ObligatoryNonconformanceTo <person> <act> <degree of nonconformance>),” and its three counterparts, “OptionalConformanceTo,” “ExpectedConformanceTo,” and “ExpectedNonconformanceTo.” These relations are implemented in the Act Indicators database for each act that implies such norm conformance or nonconformance. A high degree of ObligatoryNonconformanceTo implies the strongest degree of blameworthiness. ExpectedNonconformanceTo, is tempered so that even a high degree of this assessment produces a relatively low degree of blameworthiness. This kind of treatment is doubled with OptionalConformanceTo and ExpectedConformanceTo, only with respect to praiseworthiness, instead of blameworthiness.

One shortcoming of this implementation is that it tends to cover very direct semantic expectations, but does not easily denote pragmatic or contextual expectations. Of primary importance, we wanted to model the expected nonconformance attributed to contextual act mismatches. For example, certainly a patient would feel quite upset if the doctor prescribed surgery to cure a cold! We also thought it would be useful to exhibit special blame for the repetition of bad acts, and special praise for the repetition of good acts.

To implement these three concepts, we conceived the three relations “ThinksNegApplicableDeviation,” “ThinksNegReplicationDeviation,” and “ThinksPosReplicationDeviation.” These relations are implemented in the Agent Characteristics database and all pragmatically evaluate the current act’s appropriateness in terms of past acts.

Even with these relations, we must admit that our implementation is coarse and simplistic; these relations are, however, sufficient to detect rudimentary blameworthiness and praiseworthiness. The two primary constraints that these relations support are “(PraiseworthinessTo <person> <act> <degree>)” and “(BlameworthinessTo <person> <act> <degree>).” Note again the conspicuous inclusion of the person who asserts the blame or praise. Obviously the same act may elicit different appraisals from different people.

Responsibility

Though a person may consider an act praiseworthy or blameworthy, the person will not exhibit an agent based emotion unless the person finds an agent responsible for the act. Detecting responsibility is therefore very important. The responsibility may be whole or partial. This implies that there are degrees of responsibility which must be taken into account when considering the intensity of an agent based emotion. It is also evident that different scenario participants may have different opinions on who is responsible for a given act. To implement these considerations, we devised the relation “(ThinksResponsibleFor <accuser> <accused> <act> <degree of responsibility>).” This relation is declared for acts in the Act Indicators database, accompanying all conformation/nonconformation relations. Responsibility is assumed to be total for pragmatic mismatches.

Identification

When we consider the agent based emotions that are directed towards oneself, we sometimes expand the scope of the concept “oneself” to include those whom we identify with. For example, we can feel pride when a member of our family does something good, or when the company we work for prospers, or when our country aids other countries less fortunate than ours.

To capture this notion, the agent emotion detectors for pride and shame do not require that the agent involved is absolutely equal to the affected person. Instead, we check for “fuzzy” equality using the “(IdentifiesWith <affected_person> <agent> <degree_of_identification>)” constraint. Since everyone identifies with oneself, absolute equality is still detectable with this constraint. It is implemented in the Agent Characteristics database.

7. The Constraints of Object Based Emotions

The constraints of the Object Engine emotion detectors support the emotions of liking and disliking. These constraints are very simple and basic. One reason for this is that, unlike the other emotions, these object based emotions manifest themselves most evidently as dispositions, rather than the episodes. (Recall that constraints are used by the emotion detectors within the Episode Engine.) In emotional episodes we have experiences that cause new or increased liking and disliking. In emotional dispositions, however, the overall feel towards an object is represented. For example, Jake might forget to meet Jill for dinner, causing an episode of dislike; however, Jill's overall appraisal of Jake as a friend she likes is represented by Jill's disposition of liking towards him. This chapter discusses the constraints used to identify the episodic object based emotions of liking and disliking. The object based emotional appraisals manifested in dispositions are discussed in the third section of the next chapter.

Appealingness and Unappealingness

Originally, we implemented the two defining constraints of object based emotions as simply "(AppealingTo <person> <object> <degree>)" and "(UnappealingTo <person> <object> <degree>)." This method was implied by

the Ortony group's theoretical concept for liking and disliking. Whenever an object came into focus, we would simply report how appealing or unappealing the object was. This report was modified by the degree of familiarity towards the object, as embodied by the familiarity constraint we will present in the next section.

The trouble with this approach arises when objects are interpreted as agents (as is often the case), the appealingness or unappealingness towards an object *at that moment* may be quite different from the overall appraisal of the appealingness or unappealingness towards the object. For example, approval towards chicken soup as the agent that cured Jill's cold causes Jill to like chicken soup strongly at the time, however, she generally does not find chicken soup any more appealing than any other soup. This first approach tries to combine two different emotions (an immediate feeling and an overall appraisal feeling) into one report of liking or disliking.

To improve this situation we modified our original constraints to be "(ActImpliedNewAppeal <act> <person> <object> <degree>)" and "(ActImpliedNew Unappeal <act> <person> <object> <degree>)." These constraints are satisfied only if an act causes some direct episodic opinion of appealingness or unappealingness to occur. Specifically, they examine the current agent based emotions to see if an object has been interpreted as a praiseworthy or blameworthy agent.

The appraisal emotion is no longer exhibited as an episode, rather, as was

mentioned before, this detection is now delegated to the Disposition Engine. It is interesting to note that these dispositions of liking and disliking of objects that happen also to be agents are considered by the Event Engine. When we analyze the intensity of event emotions directed towards the fate of others, liking or disliking of the others must be taken into account. For example, Jake will not feel very sorry about Jill's accident if Jake does not like Jill.

Familiarity

In order to feel liking or disliking towards an object, we must be familiar with the object. That is, we must know something about it, or have had experience with it. We do not need to know everything about the object, but the more we know about it, the more sure we are of our opinion towards it. To model this idea, we implemented the constraint "(FamiliarWith <person> <object> <degree>)." Within the Agent Characteristics database, we use this relation to make a table of what each scenario participant knows about. With the degree of familiarity that this constraint provides, we are able to temper the intensity of liking and disliking.

8. Temporal Considerations

In Chapter 2, we mentioned that Bouzid [Bouzid 1990] holds there are three temporal dimensions of emotions: episodes, moods, and dispositions. In Chapter 3 we showed that our model establishes the emotional response of scenario participants in each of these dimensions using three software engines. This chapter explains in detail how each of these engines function.

Episodes

An emotional episode is defined to be an immediate emotional response to the occurrence of an event, the action of an agent, or the existence of an object. When Jack steps on Jill's foot, Jill has an emotional episode that includes distress, reproach, anger and disliking. Jill feels distress due to the pain caused by this event. She feels reproach toward Jack as the agent of the pain causing event. Anger results from the combination of distress and reproach. Jack, when focused upon as a object by Jill, is disliked for being so unthoughtful. It is not always the case that one act can cause emotions to occur in all three focus dimensions. It is clear, however, that any model of emotional episodes must at least scan all three focus dimensions for emotions, and be able to express detected emotions in the three dimensions simultaneously.

To achieve this purpose, we implemented three focus based engines within the Episode Engine. These focus based engines are the Event Engine, the Agent Engine, and the Object Engine. As we explained in the chapters on constraints, these engines contain a set of "emotion detectors." Each of these detectors use constraints to deduce the presence of an emotion in a scenario participant. In addition, the constraints have subconstraints. All subconstraints that do not involve references to the specifics of any given scenario are located in the focus engines as well. To sum up the Episode Engine's function, it delegates its job to the three focus engines; these engines either detect or do not detect an emotion directed towards their particular foci; all detected emotions are then combined by the Episode Engine to form an episodic emotional state.

It should be noted that the Episode Engine also takes into account past emotional states when determining the current episodic emotional state. Part of this is done at a constraint specific level when considering factors such as goal links to previous emotions (see Chapter 5, Section 4.) In a more general sense, the effect of the past emotional mood on the current episode is taken into account. To understand how mood effects episodes, consider the case of Ralph, who early on Sunday morning discovered that his car had been stolen during the night. As it happened, it was also Ralph's birthday and his family came over to take Ralph out to a festive Sunday Brunch, which ordinarily would have made Ralph quite joyous; but he was so distraught over his car, that he just could not show much enthusiasm. To make matters worse, Ralph stubbed his toe on a crack in the sidewalk while walking to the

restaurant. This made Ralph remarkably upset! When we analyze this poor state of affairs for Ralph, our first observation is that the loss of Ralph's car put him in a foul mood. When his family came to treat him to a birthday brunch, this mood reduced the intensity of this normally joyous episode. Finally, when he tripped on the crack, his mood intensified his episode of distress, causing him to be "remarkably upset."

When we consider the combination of a mood emotion and an episode emotion, we identify three possible cases: 1) the mood emotion contradicts the episode emotion, 2) the mood emotion complements the episode emotion, and 3) the mood emotion has no effect on the episode emotion. For example, in the first case, a mood of distress would contradict an episode of joy. In the second case, a mood of joy would complement an episode of joy. In the third case, a mood of hope would have no effect on an episode of reproach. The Episode Engine will reduce the intensity of an episode emotion if it is contradicted by the mood. If the mood is strong, then the amount of reduction is greater. It is possible that an episode emotion can be completely canceled out by a mood. The Episode Engine will increase the intensity of an episode emotion if it is complemented by a mood. Finally, of course, it will not change the episode intensity if the mood neither contradicts, nor complements the mood.

Moods

Bouzid defined a mood to be the prevailing feelings experienced by someone

over a period of time. After studying the issue carefully, we came to the conclusion that a mood starts as the result of some emotional episode and persists, getting weaker and weaker due to the mind focusing on new episodes and forgetting old ones, until it either dies out or is replaced by a new emotional episode. How long a mood lasts depends on several factors. For our model, we based this mood lifetime on 1) the intensity of the original eliciting episode, 2) the “emotional persistence” of the person feeling the mood, 3) the intensity of new episodes “competing” to form a new mood, 4) the effect of new episodes that are complementary or contradictory to the mood, and 5) default mood replacements for prospective moods that have been confirmed or disconfirmed by an emotional episode.

Given the intensity of the original eliciting episode, we assign to the mood an initial “lifespan” value. The greater the intensity, the greater the initial lifespan. Every time a new input act is accepted, this lifespan is reduced by a factor determined by the emotional persistence of the affected person. Emotional persistence is simply an index that indicates just how prone a person is to retaining an emotional state. If a new emotional episode results from the input act, and the intensity of the episode implies that the new episode has a more virile lifespan than the mood, then the mood is replaced. It is possible for a new emotional episode to occur that is contradictory to the mood, yet does have an intensity strong enough to replace the mood. In this case the old mood remains, but its lifespan is reduced and may soon die out as a result. It may also be the case that an emotional episode complements the mood. This causes the lifespan of the mood to be boosted.

In general, this is how moods are maintained by the model. There is one exception, however, indicated by the fifth factor mentioned earlier. When a mood is based on a prospective emotion such as hope or fear towards some future event achieving or inhibiting a goal, the confirmation (or disconfirmation) of the future event will immediately replace the mood. For example, if Jill has a mood associated with fear that Jack will not come home safe tonight, and then later Jack actually shows up unharmed, Jill's fear mood will be immediately replaced by relief.

This fifth factor exhibits a subtle change in the way we generally treat moods. Up until this point, once a mood exists, its original focus is disregarded. This characteristic of moods allows them to effect episodes that are not specifically related to the mood, as we showed in the last section. (Note that Ralph projected his distressed mood towards the brunch joy episode, even though the original focus of the mood had nothing to do with being treated to a brunch.)

In order to support this fifth factor we must retain the focus of the mood's eliciting episode to compare it for a match in the case of prospective confirmations and disconfirmations. This match checking insures that we do not discard a prospective emotion mood, unless the particular prospect involved (rather than some other prospect) is confirmed or disconfirmed. We would not want a mood of fear towards being robbed to be automatically canceled because the affected person happened to have an episode of fears-confirmed towards contracting chicken-pox. They are completely unrelated.

Dispositions

Bouzid defines dispositions to be feelings towards particular foci that do not change with respect to time. He gives the example of a person who generally dislikes strawberries. The person may not have this disposition on the forefront of his mind until someone sets a strawberry pie in front of him.

We decided to delve deeper into the formation and maintenance of dispositions. It seems intuitive that if we eat strawberries a number of times and each time we dislike them, then we form a disposition of disliking towards them. If later in life we have a number of contradictory instances of liking strawberries, then the disposition dissolves. Note that the end of the disposition is not caused by the flow of time, but rather repetitive contradictory episodes. If we are disposed to liking strawberries, and we continue to have more episodes of tasting strawberries and liking them, then our liking disposition towards strawberries is strengthened.

To specify these ideas in terms of the implementation of our Disposition Engine, any continually reoccurring emotional episode directed towards the same focus shall become a disposition. If this disposition is contradicted a number of times by later emotional episodes, then the disposition is reversed; that is, it will now institute the contradicting emotion as the disposition. If the disposition is complemented by later emotional episodes, then its degree is intensified. Even if a disposition is not created or changed by the current episode emotions, it is still reported by the Disposition Engine as relevant if

its focus matches the focus of one of the current episode emotions.

How many times a disposition needs to be contradicted or complemented in order to change is a factor of the person having the disposition. We model this factor with a “open-mindedness” relation which we implemented in the Agent Characteristics database. The more open minded a person is, the easier it is to change the person’s dispositions, and the harder it is to form new dispositions. Thus, the open-mindedness index dictates the number of episodes needed to create and change dispositions.

In the next chapter, we again focus on the Episode Engine, only this time we will examine the high-level construction of each emotion detector within the focus engines of the Episode Engine. The reason that the Mood Engine and the Disposition Engine do not have emotion detectors is because they express the temporal variations of emotions that have already been detected by the Episode Engine. In essence, they sustain a person’s emotional condition.

In summary, a scenario participant experiences states of emotions through out time. These states include episodes, moods and dispositions. The current state of emotion in the three temporal dimensions often depends on past emotional states. For example, the past mood may strengthen or weaken the current episode. The past mood also often carries over to the current mood. In the case of confirmation and disconfirmation emotions, the past episode may affect the current episode (e.g., hope in the past gives way to satisfaction in the present). Each emotional state also depends on the mental conditions

and characteristics of the scenario participant. These conditions and characteristics are accounted for by emotion constraints. To identify each emotional state, our model maintains a clock and puts a timestamp on each state. The clock “ticks” once per input act. This summary is shown graphically in Figure 4.

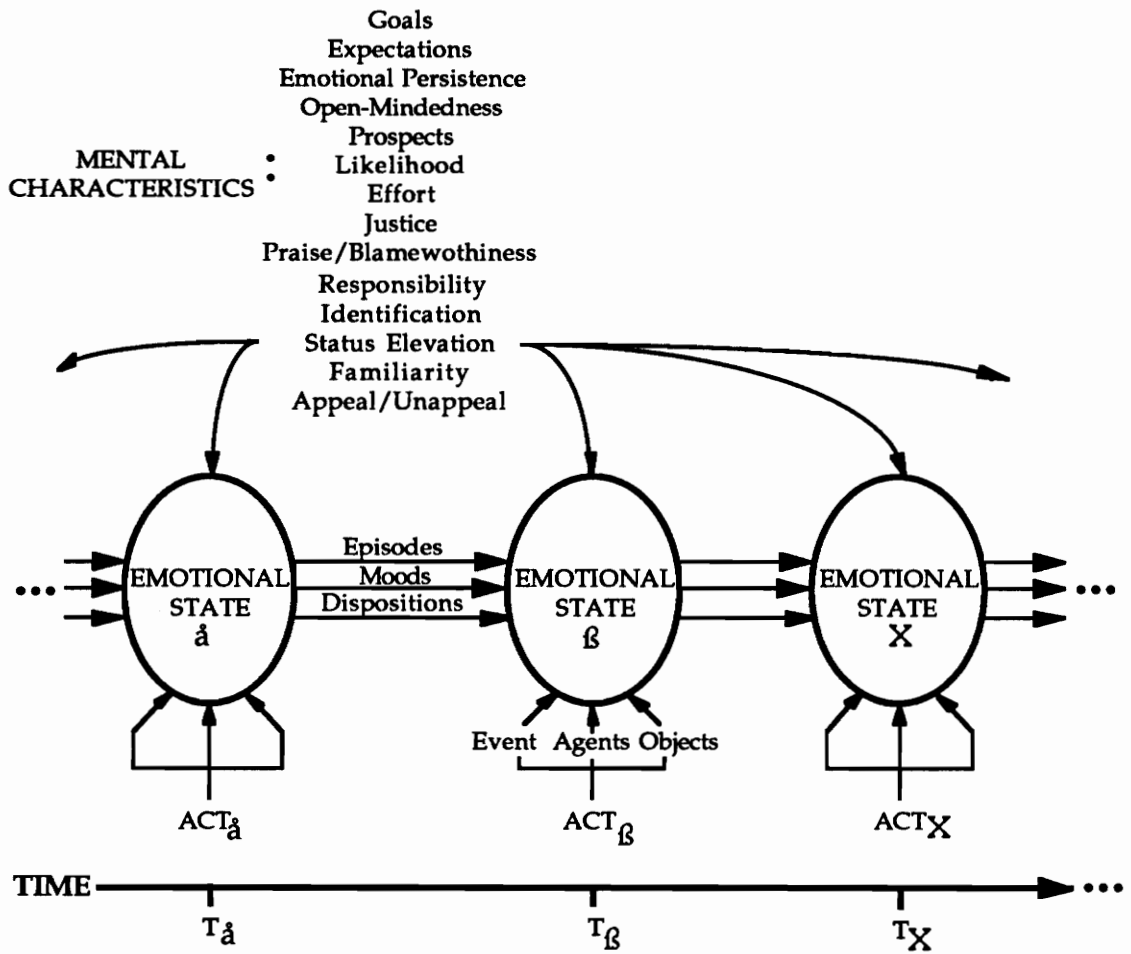


Figure 4. Overview of Emotional States through Time

9. The Construction of Emotions

In previous chapters, we have mentioned how the “emotion detectors” of the Event, Agent, and Object Engines deduce the existence of a episodic emotions in a scenario participant. Episodic emotions may, in turn, be adopted as moods and/or dispositions. For each emotion that our model is able to perceive, there is a detector for that emotion. The exception to this assertion is the compound emotions, but compound emotions are simply an “after-the-fact” supposition based of the existence of two detected basic emotions. Only basic emotions are represented in the emotional state of a scenario participant. The model provides the compound emotions as second order information only.

Each emotion detector uses the following basic, 4-step algorithm:

- 1) Prove that all **necessary** constraints of the emotion are met by the input act and contextual conditions. If this step is successful, go on to step 2, otherwise report failure to detect the emotion.
- 2) Prove as many **optional** constraints as possible to assist in establishing an accurate intensity of the emotion.
- 3) Discern the complete focus of the emotion.
- 4) Calculate the intensity of the emotion and report success.

Most detectors are based on the emotional qualities originally set down by the

Ortony group. For the emotions that we added to the model (namely: desire, despair, aspiration, dread, spite, and coveting), the same style of qualities is used. In this chapter we examine each of the detectors in detail and show how our implementation compares to the Ortony group's original concept.

Determining the Intensity of Emotions

Before proceeding further, we should first explain the subalgorithm used by each detector to discern the intensity of an emotion. Each constraint within a detector has some degree associated with it (e.g., the degree of achievement, the degree of identification, or the degree of familiarity). Each emotion detector must combine these degrees to form the overall emotional intensity. The Ortony group did not offer much help in making this combination. Here is what they have to say on the subject:

"In general, we do not attempt to arbitrate between different intensity variables with respect to the relative degrees to which they contribute to the intensity of the emotions they affect. Our reason for this is that the issue is an empirical one for which, in most cases, relevant data does not yet exist." [Ortony et al. 1988]

All they are willing to commit to is that each constraint degree either raises or lowers the intensity of a given emotion. They do not assert that some constraint degrees have more power than others, nor do they indicate that the raising or lowering of the intensity is linear or some other function type. In response to this, we have developed our own scheme for discerning the

intensity of emotions that simply assures that if high constraint degrees will increase the intensity of the given emotion; and conversely, low constraint degrees will decrease the intensity of the given emotion. We make no claims as to the empirical validity of the amount of increase or decrease. As the Ortony group implies, not enough information is known to quantify these adjustments very accurately.

Specifically, our method for determining intensity is as follows:

- 1) Determine the “base-line” degree as indicated by the most critical constraint of the emotion.
- 2) For each of the other degrees given by other necessary or optional constraints, compute a new degree based on the base-line degree, raised or lowered by the other degree.
- 3) Average all the new computed degrees.
- 4) Raise or lower this average degree if the mood complements or contradicts the emotion involved.
- 5) Report this final degree as the the emotion intensity.

In this way, all constraint degrees are taken into account, and none except the most critical degree is given an advantage over the others in determining the intensity. In the following sections, we will indicate which constraints we considered to be the most critical for each detector.

JOY and DISTRESS

The emotions of joy and distress indicate the most basic appraisal of an event.

The Ortony group describes them as follows:

"JOY EMOTIONS

TYPE SPECIFICATION: (pleased about) a desirable event

TOKENS: contented, cheerful, delighted, ecstatic, elated, euphoric, feeling good, glad, happy, joyful, jubilant, pleasantly surprised, pleased, etc.

VARIABLES AFFECTING INTENSITY:

(1) the degree to which the event is desirable

EXAMPLE: The man was pleased when he realized he was to get a small inheritance from an unknown distant relative."

"DISTRESS EMOTIONS

TYPE SPECIFICATION: (displeased about) an undesirable event

TOKENS: depressed, distressed, displeased, dissatisfied, distraught, feeling bad, feeling uncomfortable, grief, homesick, lonely, lovesick, miserable, regret, sad, shock, uneasy, unhappy, upset, etc.

VARIABLES AFFECTING INTENSITY:

(1) the degree to which the event is undesirable

EXAMPLE: The driver was upset about running out of gas on the freeway."

(All references to the Ortony group throughout this chapter, and this thesis as a whole, come from [Ortony 1988]). Note that the Ortony group expresses emotional "types." This is to give the idea that the emotion embodies all of the given emotion "tokens." The Ortony group later explains that the desirableness of the event is based on how much the event achieved the goals of the affected person and how important those goals were to the affected person. With this explanation in mind, here is our implementation of the

two emotions:

EMOTION: JOY

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

EventAchieved(self)Goal yields goal and degree of achievement

DesirablenessOf(self)Goal yields degree of desirableness

OPTIONAL CONSTRAINTS:

nil

FOCUS: Event + goal

BASE DEGREE: degree of desirableness

EMOTION: DISTRESS

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

EventInhibited(self)Goal yields goal and degree of inhibition

DesirablenessOf(self)Goal yields degree of desirableness

OPTIONAL CONSTRAINTS:

nil

FOCUS: Event + goal

BASE DEGREE: degree of desirableness

These descriptions imply that these emotions focus on an event, that the degrees of the necessary constraints must be greater than zero, that the final focus includes both the event and the cognitive goal, and that the base degree is the base-line for calculating the emotional intensity. All information extracted by the success of a constraint is indicated after the word "yields." All degrees yielded are factored into the intensity of the emotion. For each emotion we will discuss in the following sections, we will give the Ortony group description and then our implementation in the same fashion.

DESIRE, HOPE, DESPAIR and ASPIRATION

The emotions of desire, hope, despair and aspiration all involve looking toward a positive prospect; that is, a prospect that would achieve some goal. The Ortony group just supported one of the emotions, hope, as follows:

“HOPE EMOTIONS

TYPE SPECIFICATION: (pleased about) the prospect of a desirable event

TOKENS: anticipation, anticipatory excitement, excitement, expectancy, hope, hopeful, looking forward to, etc.

VARIABLES AFFECTING INTENSITY:

(1) the degree to which the event is desirable

(2) the likelihood of the event

EXAMPLE: As she thought about the possibility of being asked to the dance, the girl was filled with hope.”

We have implemented this theoretical definition as follows:

EMOTION: HOPE

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

PossibleFuture(self)GoalAchievement yields future event, goal, and degree of achievement

DesirablenessOf(self)Goal yields degree of desirableness

LikelihoodOfFutureEventOccuring yields degree of likelihood

OPTIONAL CONSTRAINTS:

nil

FOCUS: Event + goal

BASE DEGREE: degree of desirableness

After considering the necessity of likelihood for hope, we decided that it would also be a good idea to implement “desire” which is the same as hope,

except likelihood need not be considered. John can desire to be a multimillionaire, even though he does not consider the likelihood of actually becoming one. Specifically, desire is implemented as follows:

EMOTION: DESIRE
PRELIMINARY FOCUS: Event
NECESSARY CONSTRAINTS:
 PossibleFuture(self)GoalAchievement yields future
 event, goal, and degree of achievement
 DesirablenessOf(self)Goal yields degree of desirableness
OPTIONAL CONSTRAINTS:
 nil
FOCUS: Event + goal
BASE DEGREE: degree of desirableness

Note that one of the tokens of hope as defined by the Ortony group is "despair." The group later mentions that despair is really hope coupled with the knowledge that there is literally no likelihood of the hoped for prospect coming true. To capture this idea, we implemented the following detector for despair:

EMOTION: DESPAIR
PRELIMINARY FOCUS: Event
NECESSARY CONSTRAINTS:
 PossibleFuture(self)GoalAchievement yields future
 event, goal, and degree of achievement
 DesirablenessOf(self)Goal yields degree of desirableness
 LikelihoodOfFutureEventOccuring yields degree of
 likelihood
SPECIAL CONDITION:
 degree of likelihood = zero
OPTIONAL CONSTRAINTS:
 nil
FOCUS: Event + goal
BASE DEGREE: degree of desirableness

When we considered the 250 emotion terms (or tokens as the Ortony group calls them), it was evident that there was a special kind of hope that perhaps is captured in the connotation of the term “high-hopes.” This kind of hope occurs when some increase in personal social status is directly connected with the prospect involved (see the last section of Chapter 5). We call this kind of hope aspiration, and we implemented it as follows:

EMOTION: ASPIRATION

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

PossibleFuture(self)GoalAchievement yields future event, goal, and degree of achievement

DesirablenessOf(self)Goal yields degree of desirableness

LikelihoodOfFutureEventOccuring yields degree of likelihood

GoalImpliesElevationOf(self) yields degree of elevation

OPTIONAL CONSTRAINTS:

nil

FOCUS: Event + goal

BASE DEGREE: degree of elevation

FEAR and DREAD

The emotions of fear and dread are both prospective emotions that focus on the possibility of something undesirable happening. The Ortony group defines fear as follows:

“FEAR EMOTIONS

TYPE SPECIFICATION: (displeased about) the prospect of an undesirable event

TOKENS: apprehensive, anxious, cowering, dread, fear, fright, nervous, petrified, scared, terrified, timid, worried, etc.

VARIABLES AFFECTING INTENSITY:

(1) the degree to which the event is undesirable

(2) the likelihood of the event

EXAMPLE: The employee, suspecting he was no longer needed, feared that he would be fired."

The most important distinction we had to raise between this theoretical concept and an actual implementation is the fact that to actually implement fear, there must be an eliciting event that starts a person thinking about the prospective event. For example, when Jill saw Jack playing recklessly on top of the hill, she feared that Jack would fall down the hill. There may in fact be several eliciting events that cause a prospective emotion to be "triggered." In our description of fear below, recall that the constraint "PossibleFutureGoalInhibition" takes the current event as input. This current event must be a prospective "trigger," otherwise, the constraint will fail.

EMOTION: FEAR

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

PossibleFuture(self)GoalInhibition yields future event, goal, and degree of inhibition

DesirablenessOf(self)Goal yields degree of desirableness

OPTIONAL CONSTRAINTS:

LikelihoodOfFutureEventOccuring yields degree of likelihood

FOCUS: Event + goal

BASE DEGREE: degree of desirableness

Note that the likelihood constraint of fear is considered optional, unlike with hope, where it is considered necessary. Like desire, we believe that likelihood

may not always be considered when fear is exhibited. Certainly, if the likelihood is considered, it should have an effect on the intensity of the fear. Dread, on the other hand, requires that the likelihood is considered absolute. For example, Tom dreaded the meeting with his boss that he knew would be terribly boring. Here is our implementation of dread:

EMOTION: DREAD

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

PossibleFuture(self)GoalInhibition yields future event,
goal, and degree of inhibition

DesirablenessOf(self)Goal yields degree of desirableness

LikelihoodOfFutureEventOccuring yields degree of
likelihood

SPECIAL CONDITION:

degree of likelihood = absolute

OPTIONAL CONSTRAINTS:

nil

FOCUS: Event + goal

BASE DEGREE:

SATISFACTION and FEARS-CONFIRMED

Satisfaction and fears-confirmed are the two "confirmation emotions" implemented in our model. They require that something hoped for or feared in the past has come true in the present. Here is how the Ortony group defines them:

"SATISFACTION EMOTIONS

TYPE SPECIFICATION: (pleased about) the confirmation
of the prospect of a desirable event

TOKENS: gratification, hopes-realized, satisfaction, etc.

VARIABLES AFFECTING INTENSITY:

- (1) the intensity of the attendant hope emotion
- (2) the effort expended in trying to attain the event
- (3) the degree to which the event is realized

EXAMPLE: When she realized that she was indeed being asked to go to the dance by the boy of her dreams, the girl was gratified."

"FEARS-CONFIRMED EMOTIONS

TYPE SPECIFICATION: (displeased about) the confirmation of the prospect of an undesirable event

TOKENS: fears-confirmed, worst fears realized

VARIABLES AFFECTING INTENSITY:

- (1) the intensity of the attendant fear emotion
- (2) the effort expended in trying to prevent the event
- (3) the degree to which the event is realized

EXAMPLE: The employee's fears were confirmed when he learned that he was indeed going to be fired."

Note that for the first time, the Ortony group specifically mentions the degree of realization in their list of variables affecting intensity. We consider the degree of realization (or achievement) in all event based emotions. Here is our implementation of satisfaction and fears-confirmed:

EMOTION: SATISFACTION

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

EventAchieved(self)Goal yields goal and degree of achievement

GoalLinkToPreviousEmotion (to DESIRE, HOPE or ASPIRATION) yields degree of hope

DesirablenessOfGoal yields degree of desirableness

OPTIONAL CONSTRAINTS:

EffortToRealizeProspect yields degree of realization effort

FOCUS: Event + goal

BASE DEGREE: degree of hope

EMOTION: FEARS-CONFIRMED

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

EventInhibited(self)Goal **yields** degree of inhibition

GoalLinkToPreviousEmotion (to FEAR, DREAD or
DESPAIR) **yields** degree of fear

DesirablenessOfGoal **yields** degree of desirableness

OPTIONAL CONSTRAINTS:

EffortToPreventProspect **yields** degree of prevention
effort

FOCUS: Event + goal

BASE DEGREE: degree of fear

We felt that both of these emotions could be experienced without any realization or prevention effort. For example, Jack can feel relief that his friend passed the Ph.D. qualifier exams, even though Jack did not actually put personal effort into his friend's goal. Consequently, we specify effort as an optional constraint.

Also note that we specify that past despair and dread, in addition to fear, can also cause fears-confirmed to occur. This is because these emotions are simply different kinds of fear. They can be confirmed as fear is confirmed. We say this about despair, even though it is so closely aligned with hope. The justification for this is that despair can be interpreted as "something hoped for is feared not to occur because the perceived likelihood of the occurrence is zero." We also consider the emotions desire and aspiration, in addition to hope as possible causes for satisfaction, because desire and aspiration are simply different kinds of hope; they can be confirmed as hope is confirmed.

RELIEF and DISAPPOINTMENT

Relief and disappointment are “disconfirmation emotions.” Contrary to the confirmation emotions that imply something hoped for or feared has come true, the disconfirmation emotions imply something hoped for or feared has not come true. If we feel relief, then something feared did not actually occur. If we feel disappointment, then something hoped for did not actually occur. Here are the Ortony group’s definitions of these emotions:

“RELIEF EMOTIONS

TYPE SPECIFICATION: (pleased about) the
disconfirmation of the prospect of an undesirable
event

TOKENS: relief

VARIABLES AFFECTING INTENSITY:

- (1) the intensity of the attendant fear emotion
- (2) the effort in trying to prevent the event
- (3) the degree to which the event is realized

EXAMPLE: The employee was relieved to learn that he was not going to be fired.”

“DISAPPOINTMENT EMOTIONS

TYPE SPECIFICATION: (displeased about) the
disconfirmation of the prospect of a desirable event

TOKENS: dashed-hopes, despair disappointment,
frustration, heartbroken etc.

VARIABLES AFFECTING INTENSITY:

- (1) the intensity of the attendant hope emotion
- (2) the effort expended in trying to attain the event
- (3) the degree to which the event is realized

EXAMPLE: The girl was disappointed when she realized that she would not be asked to the dance after all.”

Here are our implementations of these emotions. Note that the issues taken

into account are very similar to the confirmation emotion implementations.

EMOTION: RELIEF

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

EventAchieved(self)Goal yields goal and degree of achievement

GoalLinkToPreviousEmotion (to FEAR, DREAD or DESPAIR) yields degree of fear

DesirablenessOfGoal yields degree of desirableness

OPTIONAL CONSTRAINTS:

EffortToPreventProspect yields degree of prevention effort

FOCUS: Event + goal

BASE DEGREE: degree of fear

EMOTION: DISAPPOINTMENT

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

EventInhibited(self)Goal yields degree of achievement

GoalLinkToPreviousEmotion (to DESIRE, HOPE, or ASPIRATION) yields degree of hope

DesirablenessOfGoal yields degree of desirableness

OPTIONAL CONSTRAINTS:

EffortToRealizeProspect yields degree of realization effort

FOCUS: Event + goal

BASE DEGREE: degree of hope

HAPPY-FOR and SORRY-FOR

The Ortony group calls happy-for and sorry-for “fortunes-of-others emotions,” or “good-will emotions.” They indicate specifically the feelings that we feel towards good or bad things happening to people we like.

“HAPPY-FOR EMOTIONS

TYPE SPECIFICATION: (pleased about) an event
presumed to be desirable for someone else

TOKENS: delighted-for, happy-for, pleased-for, etc.

VARIABLES AFFECTING INTENSITY:

- (1) the degree to which the desirable event for the other is desirable for oneself
- (2) the degree to which the event is presumed to be desirable for the other person
- (3) the degree to which the other person deserved the event
- (4) the degree to which the other person is liked

EXAMPLE: Fred was happy for his friend Mary because she won a thousand dollars.”

“SORRY-FOR EMOTIONS

TYPE SPECIFICATION: (displeased about) an event
presumed to be undesirable for someone else

TOKENS: compassion, pity, sad-for, sorry-for, sympathy,
etc.

VARIABLES AFFECTING INTENSITY:

- (1) the degree to which the undesirable event for the other is undesirable for oneself
- (2) the degree to which the event is presumed to be undesirable for the other person
- (3) the degree to which the other person did not deserve the event
- (4) the degree to which the other person is liked

EXAMPLE: Fred was sorry for his friend Mary because her husband was killed in a car crash.”

Here are our implementations for these emotions:

EMOTION: HAPPY-FOR

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

EventAchieved(other’s)Goal yields other’s goal and
degree of other’s achievement

DesirablenessOf(other’s)Goal yields degree of other’s
goal desirableness

not (self)PredisposedToDislike(other)
not EventInhibited(self)Goal
OPTIONAL CONSTRAINTS:
EventAchieved(self)Goal yields self's goal and degree of self's achievement
DesirablenessOf(self)Goal yields degree of self's goal desirableness
(self)Feels(other)DeservingOf yields degree of deserving
(self)PredisposedToLike(other) yields degree of liking
FOCUS: Event + other's goal
BASE DEGREE: degree of other's desirableness

EMOTION: SORRY-FOR
PRELIMINARY FOCUS: Event
NECESSARY CONSTRAINTS:
EventInhibited(other's)Goal yields other's goal and degree of other's inhibition
DesirablenessOf(other's)Goal yields degree of other's goal desirableness
not (self)PredisposedToDislike(other)
OPTIONAL CONSTRAINTS:
EventInhibited(self)Goal yields self's goal and degree of self's inhibition
DesirablenessOf(self)Goal yields degree of self's goal desirableness
(self)Feels(other)UndeservingOf yields degree of undeserving
(self)PredisposedToLike(other) yields degree of liking
FOCUS: Event + other's goal
BASE DEGREE: degree of other's desirableness

Note that it is possible to feel happy-for or sorry-for someone about whom we have not formed an opinion of liking towards. Consequently, the liking constraint is optional. We do, however, maintain that these emotions would not occur if there was a previously formed opinion of disliking for the other person. Thus, this is stipulated as a necessary constraint.

RESENTMENT

Resentment is what we feel when something happens that is good for someone else, but bad for us. For example, Jill got the job instead of John, so John resented Jill. Here is the Ortony group specification:

“RESENTMENT EMOTIONS

TYPE SPECIFICATION: (displeased about) an event
presumed to be desirable for someone else

TOKENS: envy, jealousy, resentment, etc.

VARIABLES AFFECTING INTENSITY:

- (1) the degree to which the desirable event for the other person is undesirable for oneself
- (2) the degree to which the event is presumed to be desirable for the other person
- (3) the degree to which the other person did not deserve the event
- (4) the degree to which the other person is not liked

EXAMPLE: The executive resented the large pay raise awarded to a colleague whom he considered incompetent.”

In our implementation, we go so far as to assert that resentment occurs only when one’s goal is inhibited. This is partly because goal inhibition is how our model discerns the “undesirableness” of an event. It is possible that some other, more broad, implementation of “undesirableness” would be helpful here. This simple definition, however, is capable of detecting a good number of resentment episodes. Here is the implementation:

EMOTION: RESENTMENT

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

EventAchieved(other's)Goal yields other's goal and degree of achievement

DesirablenessOf(other's)Goal yields degree of other's goal desirableness

EventInhibited(self)Goal yields self goal and degree of self inhibition

DesirablenessOf(self)Goal yields degree of self goal desirableness

OPTIONAL CONSTRAINTS:

(self)Feels(other)UndeservingOf yields degree of undeserving

(self)PredisposedToDislike(other) yields degree of disliking

FOCUS: Event + other's goal

BASE DEGREE: degree of self goal desirableness

GLOATING

The gloating emotion is also a "fortunes-of-others" emotion, like happy-for, sorry-for and resentment. It is sorry-for's contradictory emotion. Because of our negative appraisal of another person, we feel happy that something bad happened to the other person, instead of sad. Here is the Ortony group specification:

"GLOATING EMOTIONS

TYPE SPECIFICATION: (pleased about) an event presumed to be undesirable for someone else

TOKENS: gloating Schadenfrude, etc.

VARIABLES AFFECTING INTENSITY:

- (1) the degree to which the undesirable event for the other person is desirable for oneself
- (2) the degree to which the event is presumed to be undesirable for the other person

- (3) the degree to which the other person deserved the event
 (4) the degree to which the other person is not liked
 EXAMPLE: Political opponents of Richard Nixon gloated over his ignominious departure from office"

And here is our implementation:

EMOTION: GLOATING

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

EventInhibited(other's)Goal yields other's goal and degree of inhibition

DesirablenessOf(other's)Goal yields degree of other's goal desirableness

(self)Feels(other)DeservingOf yields degree of deserving

(self)PredisposedToDislike(other) yields degree of disliking

OPTIONAL CONSTRAINTS:

EventAchieved(self)Goal yields self goal and degree of self achievement

DesirablenessOf(self)Goal yields degree of self goal desirableness

FOCUS: Event + other's goal

BASE DEGREE: degree of deserving

SPITE

Spite is an emotion that was not described by the Ortony group. We saw the need for it because it was not encapsulated in the emotion of resentment or gloating. Spite looks ahead to a future event, while resentment and gloating are centered on a current event. We can say that spite is a prospective emotion. Specifically, it occurs when a person wants something bad to

happen to another person. It is in this regard that spite is similar to hope. Here is our implementation of spite:

EMOTION: SPITE

PRELIMINARY FOCUS: Event

NECESSARY CONSTRAINTS:

PossibleFuture(other's)GoalInhibition yields other's goal and other's degree of inhibition

DesirablenessOf(other's)Goal yields degree of other's goal desirableness

(self)Feels(other)DeservingOf yields degree of deserving

(self)PredisposedToDislike(other) yields degree of disliking

OPTIONAL CONSTRAINTS:

PossibleFuture(self)GoalAchievement yields self goal and degree of self achievement

DesirablenessOf(self)Goal yields degree of self goal desirableness

FOCUS: Event + other's goal

BASE DEGREE: degree of deserving

PRIDE and SHAME

With pride and shame we enter into the domain of agent based emotions. These emotions entail the "appraisal of an agent's actions," according to the Ortony group. Specifically, these emotions require that the agent in question is either oneself, or someone we identify with. Here is the Ortony group specification for these emotions:

"PRIDE EMOTIONS

TYPE SPECIFICATION: (approving of) one's own praiseworthy action

TOKENS: pride

VARIABLES AFFECTING INTENSITY:

- (1) the degree of judged praiseworthiness
- (2) the strength of the cognitive unit with the actual agent
- (3) deviations of the agent's action from person/role-based expectations (i.e. unexpectedness)

EXAMPLE: The woman was proud of saving the life of a drowning child."

"SELF-REPROACH EMOTIONS

TYPE SPECIFICATION: (disapproving of) one's own blameworthy action

TOKENS: embarrassment, feeling guilty, mortified, self-blame, self-condemnation, self-reproach, shame, (psychologically uncomfortable, uneasy, etc.

VARIABLES AFFECTING INTENSITY:

- (1) the degree of judged blameworthiness
- (2) the strength of the cognitive unit with the actual agent
- (3) deviations of the agent's action from the person/role-based expectations (i.e. unexpectedness)

EXAMPLE: The spy was ashamed of having betrayed his country."

Note that the Ortony group refers to shame as "self-reproach." We feel the concepts are the synonymous, and chose "shame" because it is more universally recognizable. More importantly, also note that each of these specification indicate an "expectations" variable. Recall from Chapter 6 that various kinds of expectations (such as obligatory expectations and optional expectations) are taken into account by the blameworthiness and praiseworthiness constraints. Consequently, we do not implement any additional constraints for the purpose of expectation modeling. Here is our implementations of pride and shame:

EMOTION: PRIDE

PRELIMINARY FOCUS: Agent

NECESSARY CONSTRAINTS:

(self)IdentifiesWith(agent) yields degree of
identification

(self)Thinks(agent)ResponsibleFor yields degree of
responsibility

(agent)PraiseworthinessTo(self) yields degree of
praiseworthiness

OPTIONAL CONSTRAINTS:

nil

FOCUS: Agent

BASE DEGREE: degree of praiseworthiness

EMOTION: SHAME

PRELIMINARY FOCUS: Agent

NECESSARY CONSTRAINTS:

(self)IdentifiesWith(agent) yields degree of
identification

(self)Thinks(agent)ResponsibleFor yields degree of
responsibility

(agent)BlameworthinessTo(self) yields degree of
blameworthiness

OPTIONAL CONSTRAINTS:

nil

FOCUS: Agent

BASE DEGREE: degree of blameworthiness

REPROACH and APPROVAL

Reproach and approval are agent based emotions directed towards someone whom we do not identify as ourself. In all other respects, they are identical to pride and shame. Here are the Ortony specifications:

“REPROACH EMOTIONS

TYPE SPECIFICATION: (disapproving of) someone else’s
blameworthy action

TOKENS: appalled, contempt, despise, disdain,
indignation, reproach, etc.

VARIABLES AFFECTING INTENSITY:

- (1) the degree of judged blameworthiness
- (2) deviations of the agent’s action from person/role-based expectations (i.e. unexpectedness)

EXAMPLE: Many people despised the spy for having betrayed his country.”

“APPRECIATION EMOTIONS

TYPE SPECIFICATION: (approving of) someone else’s
praiseworthy action

TOKENS: admiration, appreciation, awe, esteem, respect,
etc.

VARIABLES AFFECTING INTENSITY:

- (1) the degree of judged praiseworthiness
- (2) deviation of the agent’s action from person/role-based expectations (i.e. unexpectedness)

EXAMPLE: The physicist’s colleagues admired him for his Nobel-prize-winning work.”

And here are our implementations:

EMOTION: REPROACH

PRELIMINARY FOCUS: Agent

NECESSARY CONSTRAINTS:

not (self)IdentifiesWith(agent)

(self)Thinks(agent)ResponsibleFor yields degree of
responsibility

(agent)BlameworthinessTo(self) yields degree of
blameworthiness

OPTIONAL CONSTRAINTS:

nil

FOCUS: Agent

BASE DEGREE: degree of blameworthiness

EMOTION: APPROVAL

PRELIMINARY FOCUS: Agent

NECESSARY CONSTRAINTS:

not (self)IdentifiesWith(agent)

(self)Thinks(agent)ResponsibleFor yields degree of responsibility

(agent)PraiseworthinessTo(self) yields degree of praiseworthiness

OPTIONAL CONSTRAINTS:

nil

FOCUS: Agent

BASE DEGREE: degree of praiseworthiness

LIKING and DISLIKING

The appraisal of objects is embodied by the emotions of liking and disliking. When emotional intensity is considered, these emotions can range from deep love to great hate. Here are the Ortony group specifications:

"LIKING EMOTIONS

TYPE SPECIFICATION: (liking) an appealing object

TOKENS: adore, affection, attracted-to, like, love, etc.

VARIABLES AFFECTING INTENSITY:

(1) the degree to which the object is appealing

(2) the degree of familiarity with the object

EXAMPLE: Mary was filled with affection as she gazed at her newborn infant."

"DISLIKING EMOTIONS

TYPE SPECIFICATION: (disliking) an unappealing object

TOKENS: aversion, detest, disgust, dislike, hate, loathe, repelled-by, revulsion, etc.

VARIABLES AFFECTING INTENSITY:

(1) the degree to which the object is unappealing

(2) the degree of familiarity with the object

EXAMPLE: John disliked the concert so much that he left
in the middle."

Our implementation follows very closely with these specifications, except that we especially emphasize the "newness" of the appraisal. This insures that these detections are within the bounds of an emotional episode, rather than a disposition. Specifically, we implement these emotions as follows:

EMOTION: LIKING

PRELIMINARY FOCUS: Object

NECESSARY CONSTRAINTS:

(self)FamiliarWith(object) yields degree of familiarity

ActImpliedNewAppeal(toward object) yields degree of
appeal

OPTIONAL CONSTRAINTS:

nil

FOCUS: Object

BASE DEGREE: degree of appeal

EMOTION: DISLIKING

PRELIMINARY FOCUS: Object

NECESSARY CONSTRAINTS:

(self)FamiliarWith(object) yields degree of familiarity

ActImpliedNewUnappeal(toward object) yields degree
of unappeal

OPTIONAL CONSTRAINTS:

nil

FOCUS: Object

BASE DEGREE: degree of unappeal

GRATITUDE, ANGER, SELF_SATISFACTION, REMORSE and COVETING

The Ortony group describe some emotions that are compounds of the basic

emotions we have already discussed. In Table 2 we show the descriptions of these emotions. In addition to the compound emotions shown, we also attempted to implement the emotion “humiliation” as a compound emotion. Humiliation could be defined as pride towards oneself combined with the reproach of others towards oneself. The problem with this method of detecting humiliation is that it assumes the reproach of others is “taken to heart” by the affected person. If our pride is sufficiently solid, and our opinion of the others who feel reproach toward us is one of disdain, then we will not feel humiliation. We think this complexity of humiliation needs to be explored further in order to determine a satisfactory definition of the emotion. Consequently, we decided that an implementation of humiliation detection at this time would be premature.

All compound emotions are detected by the Compound Engine (see Chapter 3). They do not entail the formal implementation specification of the basic emotions. The Compound Engine simply looks for these emotion combinations at the episodic, mood, and dispositional levels and reports the combinations it finds. It also looks at combinations between the episode level and disposition level. The notion that a disposition of, say, reproach towards doctors, combined with an episode of discomfort in the doctor’s office could cause a patient to feel angry was implied by [Sloman and Croucher 1981]. They state the following:

“[An] attitude [i.e. disposition] will be expressed in tendencies to take certain decisions rather than others when the opportunity arises, but there need not be any continual disturbance of thoughts and decisions. A

mother may love her children without their being constantly in her mind, though a specific occurrence, such as news of danger to them may well interact with this attitude to produce an emotion, such as anxiety.”

When the Compound Engine makes combinations of this kind, it indicates specifically that the linkage is across the dimensions of episode and disposition.

In the next chapter, we will explain how we set up a test case for the emotion detectors outlined in this chapter. Following the next chapter, we will show the emotions that these detectors uncovered in the test case.

Table 2. The Construction of the Compound Emotions

<u>Basic Emotion #1</u>		<u>Basic Emotion #2</u>		<u>Compound Emotion</u>
“approving of someone else’s praiseworthy action (admiration (i.e. approval))	+	pleased about a desirable event (joy)	->	gratitude
disapproving of someone else’s blameworthy action (reproach)	+	displeased about an undesirable event (distress)	->	anger
approving of one’s own praiseworthy action (pride)	+	pleased about a desirable event (joy)	->	gratification (i.e., self-satisfaction)
disapproving of one’s own blameworthy action (shame)	+	displeased about an undesirable event (distress)	->	remorse”

To these we added:

disapproving of one’s own blameworthy action (shame)	+	pleased about a desirable event (joy)	->	coveting
--	---	---------------------------------------	----	----------

10. The Construction of the Patient/Doctor Scenario Test Case

As we explained in the introduction, we have constructed a test case for our model that simulates the interaction between a patient and a doctor. This test case has four components: 1) acts, 2) an acts grammar, 3) act indicators, and 4) scenario participant characteristics. In this chapter, we shall define each of these components, point out important issues, and show examples.

Before we go to these components, it is important to point out first that this scenario models a hypothetical patient and a hypothetical doctor, rather than any actual people. In hypothesizing these individuals, we tried to embody them with stereotypical characteristics. We make no claims that these characteristics are empirically accurate. Because this model is very basic in nature, we felt that simple intuitive judgments were sufficient to exhibit useful results.

Acts

All the "acts" in our test case are expressions of the state of a scenario participant. Each new act implies a new state. In the scenario of doctor/patient relations, the most important indications of state are expressed through communication acts, or "speech acts." Consequently, the

overwhelming number of our acts have to do with “asking,” “declaring,” “agreeing,” “disagreeing,” “defending,” “doubting,” “explaining,” “expressing,” “imploring,” “complaining,” and other such conversational phenomena. There are also changes of state that patients and doctors go through that are not generally communicated, like dying, taking medication, awakening after anesthesia, suppressing pain, starting tests, etc.

Our goal in developing the acts for this scenario was to provide a representative list of the kinds of things that patients and doctors do together. We did not, obviously, cover every possibility, or even close. However, we did include acts such that a patient can come to a doctor, have symptoms or illnesses expressed, examined, detected, cured or fail to be cured. Techniques of curing include medications, therapies and surgeries. We included procedural formalities such as taking off clothes and filling out forms. We have social acts such as showing extra kindness or expressing emotions directly. We have informational inquiries of all kinds such as the explanations of test procedures and the probabilities of treatment success. All told, we developed approximately 250 acts. A complete list of them can be found in appendix A.

The full syntax of representing an act is:

(<actor> <act> (<act parameter type> <act parameter>))

For example:

(Doctor DeclareSurgeryToBeMinor (surgery appendectomy))

Some acts have no parameter, for example:

(Doctor AskToExaminePatient ())

As we will discuss in the next section, our system provides the user with a series of menus that allow the user to choose which acts actually occur as input to our emotion detecting engines. When a user chooses an act, he or she must also “fill in” the parameter, for example if the user chooses the patient’s act of declaring an illness, the user must specify which illness the patient is declaring from a list of parameter choices. All the choices will be of the same parameter type, such as the “illness” type, or as in the earlier example, the “surgery” type.

All parameters are stored in the small Parameters database (see Figure 3). The types we have developed for the doctor/patient scenario include symptoms, severities, emotions, illnesses, formalities, medications, side-effects, tests, results, durations, chances, and many others. A complete list of these can also be found in Appendix A.

A Grammar of Acts

In the last section, we mentioned that we guide the user through the input of acts with a series of menus. These menus insure, or at least attempt to insure, that a proper chronology of acts occurs. For example, the menu system will not allow the user to specify that the doctor has cured the patient of cancer before the doctor has examined and treated the patient. Our menu system is

told which acts are relevant at a given time by what is called a “pragmatic grammar.”

The kind of grammars we are generally familiar with describe how to put words together to express a correctly structured sentence. Such a grammar might specify, for example, that pronouns should come before verbs. A pragmatic grammar is similar to this kind of grammar, except that it describes how to put acts together to express a correctly structured scenario. For example, a pragmatic grammar might indicate that we put on our shoes before we tie them, or that we eat breakfast before we eat lunch.

The basic patient/doctor scenario structure that our particular pragmatic “acts” grammar mandates is as follows:

- The patient meets with the doctor and expresses symptoms, an illness or a desire for a check-up.
- The doctor investigates the patient’s problem or request. This may involve various tests and procedural formalities.
- After some number of tests the doctor will either declare that he or she understands the patient’s illness or that the patient is free of illness. There is also the possibility that the doctor never understands the illness, but goes ahead to the treatment stage anyway.
- At this point, the patient asks for, or the doctor suggests some form of treatment. This may involve medication, therapy, or surgery. The patient may accept or refuse the treatment. If the treatment is refused, some alternate treatment may be agreed upon. The patient may also wish to seek a second opinion.

- If a treatment was agreed upon, then the treatment will begin with the application of medication, the rigors of therapy, or the procedure of surgery.
- During treatment, a number of things could happen, including the statements of praise or complaints about the progress of the treatment, rejection of the treatment, prolonging of the treatment, requests to switch treatments, etc. At some point, however, the treatment stage will end.
- After the treatment is complete, its effect is evaluated by the doctor and the patient. If the treatment was unsuccessful, then other treatment will be undertaken. If the treatment was successful, then we go to the next step.
- At this point, if all the patient's ills have been cured, the patient will take leave of the doctor, probably thanking him or her in the process. Otherwise, treatment of other ills will commence.

This is a very coarse overview of the grammar's plan. There are many intricate "sub-scenarios" that the grammar attends to. We must also note that the grammar is not "perfect." For example, it would not prevent the user from having the doctor prescribe chemotherapy for a common cold. This is actually an advantage because it provides our model with unexpected acts that can be evaluated for their emotional impact. In the above example, our model would have the patient feel reproach toward the doctor for such an absurd suggestion.

Paul Grice, in his important book entitled "Studies in the Way of Words," [Grice 1989] describes what he calls "conversational maxims." His four basic maxims for "purposeful" and "rational" conversation are: 1) provide the

right quantity of things, 2) provide quality assertions, 3) stick to reasonably related topics and responses, and 4) be reasonably well mannered with your responses. When these maxims are violated, an emotional reaction could ensue. For example, if the doctor wanted to give the patient twenty tests, just to make sure that the supposed illness was a common cold, this would violate maxim number 1 and cause the patient to be upset. If the doctor prescribed a “placebo” instead of a real medication, this would violate number 2 and cause anger. When maxims are exceeded, the emotional reaction can be positive, for example if the doctor shows extra kindness toward the person, then this exceeds maxim number 4, and the patient responds with gratitude. Our “imperfect” grammar allows our model to explore these possibilities.

The Meaning of Acts

When an act is chosen as input, our model must understand the “meaning” of the act, at least in terms related to emotion detection. The underlying meanings of acts are stored in the Act Indicators database. As we explained indirectly in chapters 5, 6, and 7, these meanings provide facts to the episode focus engine constraints. These facts are related through the following relations:

- (EventTo <person> <act> <event>)
- (AgentTo <person> <act> <agent>)
- (ObjectTo <person> <act> <object>)
- (EventToEventLink <person> <event> <future_event>
<likelihood_booster> <realize_booster> <prevent_booster>)

- (EventToGoalLink <person> <event> <goal> <link_nature>)
- (ObligatoryNonconformanceTo <person> <act> <degree of nonconformance>)
- (ExpectedNonconformanceTo <person> <act> <degree of nonconformance>)
- (OptionalConformanceTo <person> <act> <degree of conformance>)
- (ExpectedConformanceTo <person> <act> <degree of conformance>)
- (ThinksResponsibleFor <accuser> <accused> <act> <degree of responsibility>)
- (EventJusticeLink <accuser> <accused> <event> <event> <deserving_booster>)

No act will indicate all of these relations; in fact, some only imply the event relation and the agent relation. This is because these two relations are always satisfied automatically by an act; the act is an event, and the actor is an agent. There may be additional agents that need to be specified, such as the medication prescribed by a doctor. It is often the case that multiples of the same relation are needed to describe an act. We should also note that in the relations above “<event>” and “<act>” are really synonymous because the cognitive goal evaluation has not yet been filled into the event description. Here is an example of the relations we implemented for the act (Doctor DeclareIllnessIncurable (illness <some illness>)):

```
(EventToGoalLink Patient (Doctor DeclareIllnessIncurable (illness <illness>))
HaveDetectedAilmentsCured
-4)
(EventToGoalLink Patient (Doctor DeclareIllnessIncurable (illness <illness>))
GetCompetentDoctor
-3)
(EventToGoalLink Patient (Doctor DeclareIllnessIncurable (illness <illness>))
SecureTheHealthOfTheCurrentPatient
-5)
```

```

(EventToGoalLink Doctor (Doctor DeclareIllnessIncurable (illness <illness>))
  SatisfyTheCurrentPatient
  -4)
(ExpectedNonconformanceTo Patient
  (Doctor DeclareIllnessIncurable (illness <illness>))
  2)
(ThinksResponsibleFor Patient Doctor
  (Doctor DeclareIllnessIncurable (illness <illness>))
  5)
(ObjectTo Patient (Doctor DeclareIllnessIncurable (illness <illness>)) Doctor)
(ObjectTo Doctor (Doctor DeclareIllnessIncurable (illness <illness>)) <illness>)

```

All of these relations have been described in the chapters on constraints, so we will not restate their definitions here. This example is simply to show how the relations are used together to form a meaningful indication of what an act involves. Note how multiple instances of the goal specifying relation are used to show two goal inhibitions for each scenario participant. Also note that only the patient feels the doctor has not lived up to his expected duties. The doctor believes the fact that the illness is incurable is not his or her fault, but the patient thinks the doctor is being somewhat incompetent.

Sometimes the relations are conditional. For example, when the doctor expresses the chance of medication success, how likely it is that the doctor will later declare the patient cured depends on this chance. This situation is represented as follows:

```

(EventToEventLink <everyone>
  (Doctor ExpressChanceOfMedicationSuccess (chance <chance>))
  (Doctor DeclareCured ())
  <likelihood_booster> 0 0)
where:
  <likelihood_booster> is -2 if <chance> = "no_chance",
  <likelihood_booster> is 0 if <chance> = "improbable",
  <likelihood_booster> is 1 if <chance> = "fifty-fifty",
  <likelihood_booster> is 3 if <chance> = "probable", and
  <likelihood_booster> is 4 if <chance> = "assured".

```

Now that we have described the Act Indicator database, we will move on to the Agent Characteristics database.

The Characteristics of Agents

The most important characteristics of agents are their goals and their dispositions. As we discussed in Chapter 2, Susan Ravlin provided us with the basic technique of modeling goals and expressed some helpful examples (see Figure 1). We utilized this technique and set up our own goal hierarchies for the doctor and the patient. These hierarchies are shown in Figure 5 and Figure 6. To implement these structures in the Agent Characteristics database, we specified “(GoalToGoalLink <person> <super-goal> <sub-goal> <chance>)” relations, where “<chance>” indicates how much assurance there is that the sub-goal will bring about the achievement of the super-goal. For example, the relation “(GoalToGoalLink Patient SecurePersonalHealth HaveNoAilments 5)” implies that if the patient achieves the sub-goal of having no ailments, then there is a high chance that the super-goal of securing personal health will be achieved as a result.

Dispositions were implemented with a “(<type>Disposition <emotion> <degree> <object> <affected person>)” relation. For example, the patient’s disposition of medium liking for chicken soup was represented by “(ObjectDisposition Liking 3 chicken_soup Patient)” These dispositions can change as the Disposition Engine considers new episodes.

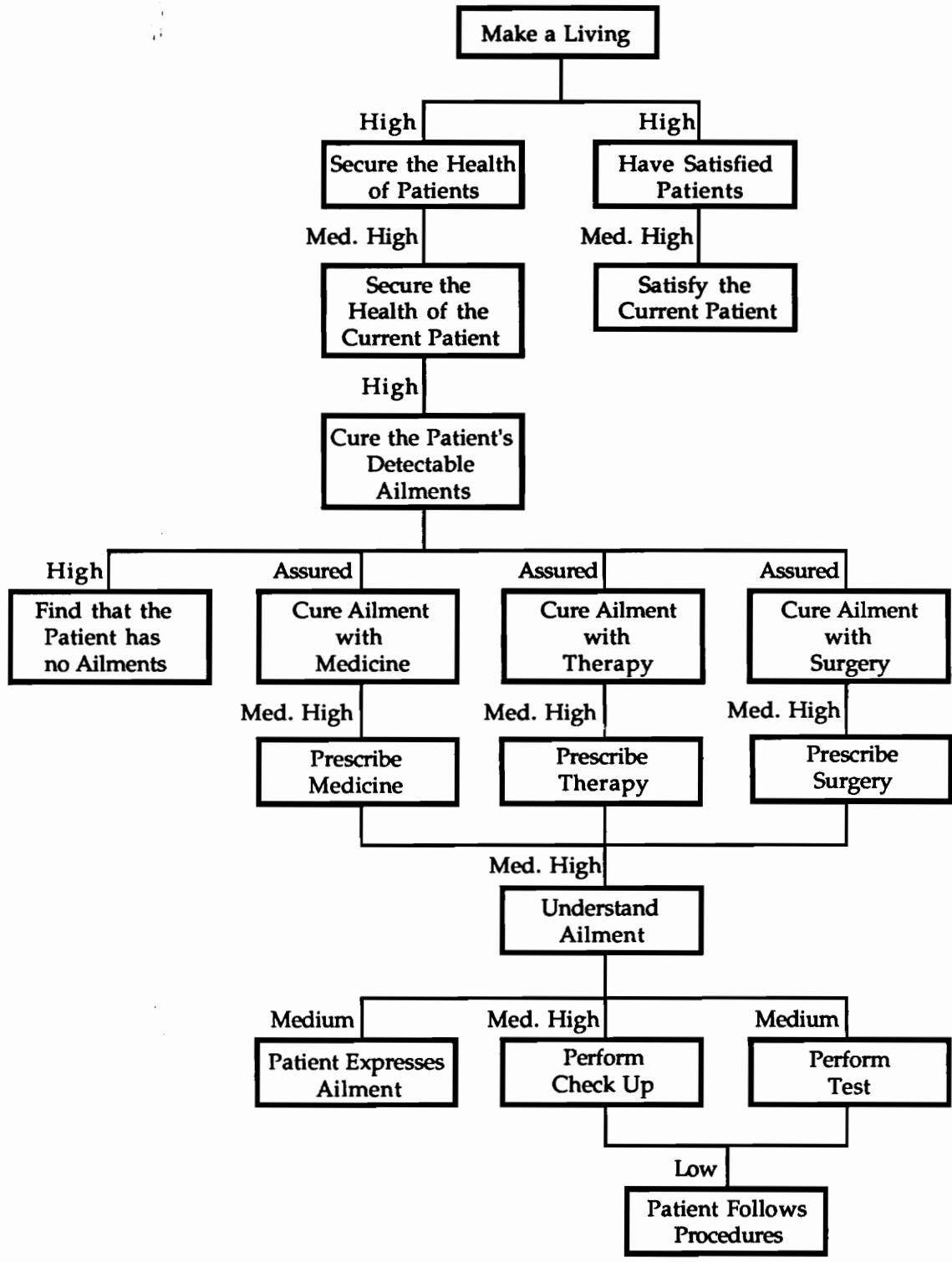


Figure 5. Doctor's Goal Hierarchy

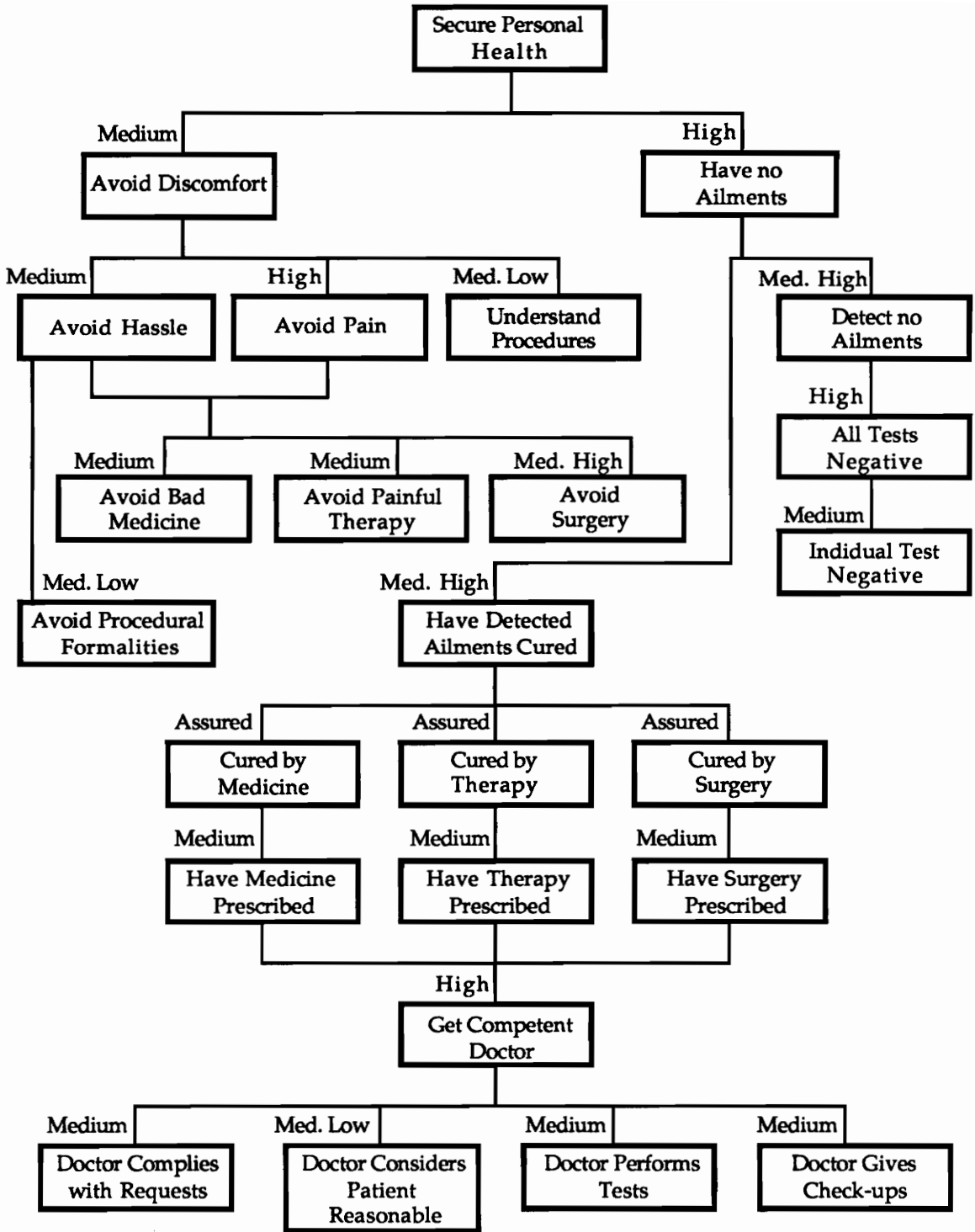


Figure 6. Patient's Goal Hierarchy

In addition to object based dispositions, we implemented event and agent based dispositions as well. For example, the patient has the desire of always wanting to secure his personal health, as well as having the fear of pain. The patient also generally approves of doctors. In addition, the doctor has a disposition to treat patients with medications, rather than therapies and surgeries. He or she also generally feels proud of himself or herself.

Other factors specified in the Agent Characteristics database were the “open-mindedness” of the agent, to help determine disposition changes, and the “emotional persistence” of the agent, to help determine the timing of moods. We also specify what objects each agent is familiar with. Finally, we specify what the initial emotional state of each agent going in to the scenario is. For example, the patient initially is feeling distress over the discomfort of going to the doctor. The doctor on the other hand is emotionally neutral upon entering the scenario.

In the next chapter we will show how our model reacted to the acts, indicators and agent characteristics of this scenario. In the second section of Chapter 12, we will explore how some other scenarios could be implemented to utilize the model.

11. Results of the Model tested with the Patient/ Doctor Scenario

In this chapter we will show our model's responses to selected input acts. We chose these acts because together they elicit a good variety of emotions and explore the workings of much of our model. These acts have been extracted from a number of complete scenario run-throughs and show some of the "highlights" of these run throughs. A complete scenario run is shown in its entirety in Appendix B.

From this point on, all output from our model will be shown in a smaller type font. Given any act, our model provides the user with a general explanation of each participant's emotional state. In addition, if the user so chooses, the model will express an in-depth analysis of the emotional states. This analysis explains why certain emotional episodes were detected and why others were not. It also provides information on the formation of the mood and disposition. For the sake of brevity, we will examine just the sections of the analysis that are immediately relevant to our line of discussion. Our first example output was produced when we chose the act (Doctor DisagreeWithPatientAssesment ()). Here is our model's general explanation of the patient's state subsequent to this act:

***** PATIENT'S EMOTIONS to: Doctor> DisagreeWithPatientAssessment

----- Episodes ----->

Low DISTRESS associated with
the Patient's desire to DoctorConsidersPatientReasonable.
Medium-low REPROACH towards Doctor
Medium-low DISLIKING for Doctor
This implies a compound emotion of medium-low ANGER.

----- Mood ----->

High HOPE associated with
the Patient's desire to HaveDetectedAilmentsCured.
Medium-low REPROACH towards Doctor
Medium-low DISLIKING for Doctor

----- Dispositions in Focus ----->

...no event emotion...
Low APPROVAL towards Doctor
Medium LIKING for Doctor

The first characteristic of this output to note is its tripartite description of episode, mood and disposition. Within each temporal dimension, event, agent and object emotions are reported. In addition, if a compound emotion was detected, then a report of it is given after the object emotion report. This was the case here because distress and reproach combine to form anger. Note also that the intensity of each emotion is provided as well as the focus of the emotion. For event based emotions, the model simply reports the cognitive goal focus and does not mention the act because it is already provided in the output header.

After an emotion state is reported, the user has the option of looking at the in-depth analysis of the state, or continuing on to the next emotion state. Here are some excerpts from the analysis provided for the state shown above:

Considering DISTRESS of the Patient...

/ The Patient has focused on

\ (Doctor DisagreeWithPatientAssessment ()) as an event.

/ The Patient feels the goal 'DoctorConsidersPatientReasonable'

\ has been inhibited to a medium-low degree.

/ The Patient believes DoctorConsidersPatientReasonable

\ is desirable to a low degree.

Patient feeling low DISTRESS appears to be evident.

Considering REPROACH of the Patient...

< The Patient has focused on the Doctor as an agent.

< The Patient holds the Doctor at high responsibility for this act.

< The Patient believes this act to be a low blameworthy act.

Patient feeling medium-low REPROACH appears to be evident.

Considering DISLIKING of the Patient...

< The Patient has focused on the Doctor as an object.

< The Patient is familiar with the Doctor to a medium degree.

Considering SHAME of the Patient...

< The Patient has focused on the Doctor as an agent.

< The Patient does not identify with the agent.

Patient feeling SHAME appears NOT to be evident.

Considering REPROACH of the Patient...

< The Patient has focused on the Doctor as an agent.

< The Patient holds the Doctor at high responsibility for this act.

< The Patient believes this act to be a low blameworthy act.

Patient feeling medium-low REPROACH appears to be evident.

/ The Patient finds the Doctor NEWLY unappealing

\ to a medium-low degree.

Patient feeling medium-low DISLIKING appears to be evident.

The less-than and slash characters on the left-hand side of each analysis section are printed to aide the reader. They group each explanation into reports of the success or failure of constituent constraints. For distress, the analysis is showing that the three constraints of 1) extracting an event, 2) showing that the event inhibits a goal, and 3) that the goal is desirable, have been met. For reproach, a similar breakdown is shown with agent based constraints. For disliking, the analysis shows the initial two constraints of

focusing on an object and being familiar with the object. To prove the third disliking episode constraint of a newly exhibited opinion of unappealingness, the model must show that the object was also the agent of reproach or shame. Consequently, the consideration of these emotions is shown in the analysis as well. Medium-low reproach was detected, so consequently, the third constraint succeeded and its success is reported in the end.

Here is the prospective emotion fear, felt by the patient as a result of the doctor asking to examine the patient:

***** PATIENT'S EMOTIONS to: Doctor> AskToExaminePatient

----- Episodes ----->
Medium-low FEAR associated with
the Patient's desire to HaveDetectedAilmentsCured.
...no agent emotion...
...no object emotion...

----- Mood ----->
High HOPE associated with
the Patient's desire to HaveDetectedAilmentsCured.
Medium-low REPROACH towards Doctor
Medium-low DISLIKING for Doctor

----- Dispositions in Focus ----->
...no event emotion...
Low APPROVAL towards Doctor
Medium LIKING for Doctor

The analysis of fear is more involved than distress or reproach:

Considering FEAR of the Patient...
/ The Patient has focused on
\ (Doctor AskToExaminePatient ()) as an event.
/ The Patient is now looking forward to the
| event (Doctor DeclareIllnessIncurable (illness ?x5)).

| If this event occurs, it will inhibit the Patient's
 \ goal of 'HaveDetectedAilmentsCured' to a medium-high degree.
 / The Patient believes HaveDetectedAilmentsCured
 \ is desirable to a medium-high degree.
 / The Patient thinks the likelihood of the future
 | event (Doctor DeclareIllnessIncurable (illness ?x5)) occurring
 \ is low.
 / The Patient's contradictory mood caused this episode's
 \ degree to be reduced from medium-high to medium-low.
 Patient feeling medium-low FEAR appears to be evident.

Note the “?x5”s shown in describing the prospective event. This indicates that the patient does not know what illness he or she may eventually be prognosed as having. Whatever the illness is, however, the patient is afraid that it may not be curable. Note that this fear is tempered later on by the low likelihood of incurableness. Also take note of the effect of mood on this episode. When this event took place, the patient was in a more positive hopeful mood, thus this caused the model to evaluate the patient’s fear as less intense.

The episode also had an effect on the mood as is exhibited by this mood analysis:

For the EVENT_MOOD:
 / The old HOPE mood had a potential of 40 life points left.
 | The FEAR episode had a potential of 20 life points.
 \ Consequently, the old mood was more pervasive.
 / The old mood and episode were contradictory.
 \ This caused the new mood's life points to be reduced to 20.
 / Each time unit, the mood's life points are reduced by 5.
 | (This is implied by the Patient's MEDIUM emotional persistence.)
 \ Consequently, this mood has a maximum potential lifetime of 4 time units.

For the AGENT_MOOD:
 < There was no episode to effect the current mood of REPROACH.
 < This mood has 15 life points left.
 / Each time unit, the mood's life points are reduced by 5.
 | (This is implied by the Patient's MEDIUM emotional persistence.)

\ Consequently, this mood has a maximum potential lifetime of 3 time units.

For the OBJECT_MOOD:

< There was no episode to effect the current mood of DISLIKING.

< This mood has 15 life points left.

/ Each time unit, the mood's life points are reduced by 5.

| (This is implied by the Patient's MEDIUM emotional persistence.)

\ Consequently, this mood has a maximum potential lifetime of 3 time units.

For the event mood, we see that the lifespan of the hope mood has been reduced by 50% as a result of the contradictory fear episode. We also see that the patient's mood lifespan is computed by reductions of the "life points" after each event (measured in "time units"). The amount of these reductions (five life points per event) is based on the MEDIUM emotional persistence of the patient.

The moods in the other focus dimensions of agents and objects were not effected by episode emotions, because no such emotions were present. Their lifespans were, however, reduced as a result of the passage of time.

In the following example we show some very emotional states of both the patient and the doctor as a result of the doctor showing extra kindness. Here is the doctor's response:

***** DOCTOR'S EMOTIONS to: Doctor> ShowExtraKindness (considerable)

----- Episodes ----->

Medium-high JOY associated with
the Doctor's desire to SatisfyTheCurrentPatient.

Medium-high PRIDE towards Doctor

...no object emotion...

This implies a compound emotion of medium-high SELF_SATISFACTION.

----- Mood ----->

High HOPE associated with
the Doctor's desire to CureThePatientsDetectableAilments.
Medium-high PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
Medium-high PRIDE towards Doctor
...no object emotion...
There is a disposition/episode compound emotion of medium-high
SELF_SATISFACTION

Note the disposition of the doctor's pride in himself forming a compound emotion with the episode of joy. This compound emotion was also detected directly within the episode engine, due to the episodic joy. Here are the analyses of the emotional episodes:

Considering JOY of the Doctor...

/ The Doctor has focused on
\ (Doctor ShowExtraKindness (severity considerable)) as an event.
/ The Doctor feels the goal 'SatisfyTheCurrentPatient'
\ has been achieved to a medium-low degree.
/ The Doctor believes SatisfyTheCurrentPatient
\ is desirable to a medium-high degree.
Doctor feeling medium-high JOY appears to be evident.

Considering PRIDE of the Doctor...

< The Doctor has focused on the Doctor as an agent.
< The Doctor feels high identification towards the Doctor.
< The Doctor holds the Doctor at high responsibility for this act.
< The Doctor believes this act to be a medium praiseworthy act.
Doctor feeling medium-high PRIDE appears to be evident.

Whenever the doctor focuses on himself or herself as an agent, his or her disposition of self pride is reported. Because of the episode of pride caused by this act, the disposition of pride was enhanced as indicated in this dispositional analysis report:

Concerning AGENTS:
/ The Doctor's disposition of PRIDE
| toward Doctor has been
\ enhanced by a complementary episode.
/ The Doctor's medium-high PRIDE
\ toward Doctor surfaced.

Here is the patient's reaction to the act of the doctor showing extra kindness:

***** PATIENT'S EMOTIONS to: Doctor> ShowExtraKindness (considerable)

----- Episodes ----->
Medium JOY associated with
the Patient's desire to GetCompetentDoctor.
Medium-high APPROVAL towards Doctor
Medium-high LIKING for Doctor
This implies a compound emotion of medium-high GRATITUDE.

----- Mood ----->
High HOPE associated with
the Patient's desire to HaveDetectedAilmentsCured.
Medium-high APPROVAL towards Doctor
Medium-high LIKING for Doctor

----- Dispositions in Focus ----->
...no event emotion...
Medium-low APPROVAL towards Doctor
Medium-high LIKING for Doctor
There is a disposition/episode compound emotion of medium GRATITUDE.

And the analysis of the episodes:

Considering APPROVAL of the Patient...
< The Patient has focused on the Doctor as an agent.
< The Patient holds the Doctor at high responsibility for this act.
< The Patient believes this act to be a medium praiseworthy act.
Patient feeling medium-high APPROVAL appears to be evident.

Considering LIKING of the Patient...
< The Patient has focused on the Doctor as an object.
< The Patient is familiar with the Doctor to a medium degree.

Considering PRIDE of the Patient...
< The Patient has focused on the Doctor as an agent.
< The Patient does not identify with the agent.
Patient feeling PRIDE appears NOT to be evident.

Considering APPROVAL of the Patient...
 < The Patient has focused on the Doctor as an agent.
 < The Patient holds the Doctor at high responsibility for this act.
 < The Patient believes this act to be a medium praiseworthy act.
 Patient feeling medium-high APPROVAL appears to be evident.

/ The Patient finds the Doctor NEWLY appealing
 \ to a medium-high degree.
 Patient feeling medium-high LIKING appears to be evident.

The next example shows the doctor hoping to cure the patient with chemotherapy:

**** DOCTOR'S EMOTIONS to: Doctor> PrescribeMedication (chemo_therapy)

----- Episodes ----->
 High HOPE associated with
 the Doctor's desire to CureThePatientsDetectableAilments.
 Medium-high PRIDE towards Doctor
 ...no object emotion...

----- Mood ----->
 High HOPE associated with
 the Doctor's desire to CureThePatientsDetectableAilments.
 Medium-high PRIDE towards Doctor
 ...no object emotion...

----- Dispositions in Focus ----->
 ...no event emotion...
 High PRIDE towards Doctor
 Medium-high DISLIKING for chemo_therapy

As we can see in the analysis of this hope, the doctor did feel that there was at least a low likelihood that the patient could be cured, despite having brain cancer. This low likelihood allowed the doctor to feel hope instead of despair.

Considering HOPE of the Doctor...
 / The Doctor has focused on
 \ (Doctor PrescribeMedication (medication chemo_therapy)) as an event.
 / The Doctor is now looking forward to the
 | event (Doctor DeclareCured ()).

| If this event occurs, it will achieve the Doctor's
 \ goal of 'CureThePatientsDetectableAilments' to a high degree.
 / The Doctor believes CureThePatientsDetectableAilments
 \ is desirable to a medium degree.
 / When (Patient ExpressSymptom (symptom fainting_spells))
 | occurred in the past, it did not change the likelihood
 \ of (Doctor DeclareCured ()) occurring.
 / When (Patient ExpressSymptomSeverity (severity great))
 | occurred in the past, it did not change the likelihood
 \ of (Doctor DeclareCured ()) occurring.
 / When (Patient ExpressAllSymptomsExpressed ())
 | occurred in the past, it boosted the likelihood
 \ of (Doctor DeclareCured ()) occurring.
 / When (Doctor PositivelyIdentifyIllness (illness brain_cancer))
 | occurred in the past, it reduced the likelihood
 \ of (Doctor DeclareCured ()) occurring.
 / The Doctor thinks the likelihood of the future
 | event (Doctor DeclareCured ()) occurring
 \ is low.
 / The Doctor's complementary mood caused this episode's
 \ degree to be increased from medium to high.
 Doctor feeling high HOPE appears to be evident.

The patient believed that the likelihood of being cured was zero. Consequently, the patient felt despair as follows:

***** PATIENT'S EMOTIONS to: Doctor> PrescribeMedication (chemo_therapy)

----- Episodes ----->

High DESPAIR associated with
 the Patient's desire to HaveDetectedAilmentsCured.
 Medium-high APPROVAL towards Doctor
 ...no object emotion...

----- Mood ----->

High DESPAIR associated with
 the Patient's desire to HaveDetectedAilmentsCured.
 Medium-high APPROVAL towards Doctor
 ...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
 Medium APPROVAL towards Doctor
 ...no object emotion...

In the following analysis of despair, note the zero likelihood being taken into account. This pessimistic attitude first surfaced when the doctor identified the patient's illness as brain cancer.

```
Considering DESPAIR of the Patient...
/ The Patient has focused on
\ (Doctor PrescribeMedication (medication chemo_therapy)) as an event.
/ The Patient is now looking forward to the
| event (Doctor DeclareCured ()).
| If this event occurs, it will achieve the Patient's
\ goal of 'HaveDetectedAilmentsCured' to a medium-high degree.
/ The Patient believes HaveDetectedAilmentsCured
\ is desirable to a medium-high degree.
/ When (Patient ExpressSymptom (symptom fainting_spells))
| occurred in the past, it did not change the likelihood
\ of (Doctor DeclareCured ()) occurring.
/ When (Patient ExpressSymptomSeverity (severity great))
| occurred in the past, it did not change the likelihood
\ of (Doctor DeclareCured ()) occurring.
/ When (Patient ExpressAllSymptomsExpressed ())
| occurred in the past, it boosted the likelihood
\ of (Doctor DeclareCured ()) occurring.
/ When (Doctor PositivelyIdentifyIllness (illness brain_cancer))
| occurred in the past, it reduced the likelihood
\ of (Doctor DeclareCured ()) occurring.
/ The Patient thinks the likelihood of the future
| event (Doctor DeclareCured ()) occurring
\ is zero.
Patient feeling high DESPAIR appears to be evident.
```

As the patient took the medication, the doctor was hopeful that the chemotherapy would work. After the treatment was finished, and the patient was examined, the doctor declared that the treatment was indeed beneficial. As a result, the doctor felt satisfaction:

```
***** DOCTOR'S EMOTIONS to: Doctor> ExpressMedicationEffect (beneficial)

----- Episodes ----->
High SATISFACTION associated with
the Doctor's desire to CureAilmentWithMedicine.
...no agent emotion...
```

...no object emotion...

----- Mood ----->

High SATISFACTION associated with
the Doctor's desire to CureAilmentWithMedicine.

Medium-high PRIDE towards Doctor

...no object emotion...

----- Dispositions in Focus ----->

Medium DESIRE associated with
the Doctor's desire to CureAilmentWithMedicine.

High PRIDE towards Doctor

...no object emotion...

Note that the analysis of the satisfaction refers back to the previous hope emotion:

Considering SATISFACTION of the Doctor...

/ The Doctor has focused on

\ (Doctor ExpressMedicationEffect (effect beneficial)) as an event.

/ The Doctor feels the goal 'CureAilmentWithMedicine'

\ has been achieved to a medium-high degree.

/ The Doctor did not feel DESIRE toward

\ the goal attending this event in the past.

/ The Doctor previously felt high HOPE focused on

\ the goal attending this event.

/ The Doctor believes CureAilmentWithMedicine

\ is desirable to a medium degree.

/ When (Patient AgreeToTakeMedication (medication chemo_therapy))

| occurred in the past, it did not indicate effort toward

\ realizing (Doctor ExpressMedicationEffect (effect beneficial)).

/ The system is not aware of Doctor

\ expending effort to realize this event.

Doctor feeling high SATISFACTION appears to be evident.

Note that the model did not detect effort on the part of the doctor. This is because it is not taking into account that the treatment process specifically related to chemotherapy requires considerable doctor assistance. Normally, medication is taken by the patient without help. The model is not quite

sophisticated enough to pick up on this distinction for chemotherapy medication.

In our next example, the doctor has requested that the patient take a blood test. This set off a mood of disappointment due to the disconfirmation of the patients hope to avoid pain. Here the patient is also worried about the cost of the test:

***** PATIENT'S EMOTIONS to: Patient> AskTestCost (blood_test)

----- Episodes ----->

Medium-low FEAR associated with
the Patient's desire to AvoidHassle.

...no agent emotion...

...no object emotion...

----- Mood ----->

High DISAPPOINTMENT associated with
the Patient's desire to AvoidPain.

...no agent emotion...

Medium DISLIKING for Doctor

----- Dispositions in Focus ----->

...no event emotion...

...no agent emotion...

...no object emotion...

But fortunately, the doctor explains that the cost of a blood test is nominal, so the patient feels relief as follows:

***** PATIENT'S EMOTIONS to: Doctor> ExpressTestCost (nominal)

----- Episodes ----->

Medium-low RELIEF associated with
the Patient's desire to AvoidHassle.

...no agent emotion...

...no object emotion...

----- Mood ----->
High DISAPPOINTMENT associated with
the Patient's desire to AvoidPain.
...no agent emotion...
...no object emotion...

----- Dispositions in Focus ----->
...no event emotion...
Medium-low APPROVAL towards Doctor
Medium-low LIKING for nominal

Here is the relief analysis:

Considering RELIEF of the Patient...
/ The Patient has focused on
\ (Doctor ExpressTestCost (amount nominal)) as an event.
/ The Patient feels the goal 'AvoidHassle'
\ has been achieved to a medium-low degree.
/ The Patient previously felt medium-low FEAR focused on
\ the goal attending this event.
/ The Patient believes AvoidHassle
\ is desirable to a medium-low degree.
/ The system is not aware of Patient
\ expending effort to prevent this event.
Patient feeling medium-low RELIEF appears to be evident.

If we back up a little bit, we note that when the doctor suggested the blood test,
he felt fear that the test would prove that the patient was ill:

***** DOCTOR'S EMOTIONS to: Doctor> SuggestTest (blood_test)

----- Episodes ----->
Low FEAR associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
Medium-low PRIDE towards Doctor
...no object emotion...

Later, when the doctor diagnosed the patient as having an intestinal infection,
this fear was confirmed:

***** DOCTOR'S EMOTIONS to: Doctor> PositivelyIdentifyIllness
(intestinal_infection)

----- Episodes ----->

Medium-low FEARS-CONFIRMED associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
Medium PRIDE towards Doctor
...no object emotion...

----- Mood ----->

Medium JOY associated with
the Doctor's desire to UnderstandAilment.
Medium PRIDE towards Doctor
...no object emotion...
This implies a compound emotion of medium SELF_SATISFACTION.

----- Dispositions in Focus ----->

...no event emotion...
High PRIDE towards Doctor
Medium-high DISLIKING for intestinal_infection

Considering FEARS-CONFIRMED of the Doctor..

/ The Doctor has focused on
\ (Doctor PositivelyIdentifyIllness (illness intestinal_infection)) as an event.
/ The Doctor feels the goal 'FindThatThePatientHasNoAilments'
\ has been inhibited to a medium-high degree.
/ The Doctor previously felt low FEAR focused on
\ the goal attending this event.
/ The Doctor believes FindThatThePatientHasNoAilments
\ is desirable to a medium degree.
/ When (Doctor SuggestTest (test blood_test))
| occurred in the past, it did not indicate effort toward
\ preventing (Doctor PositivelyIdentifyIllness (illness intestinal_infection)).
/ When (Patient AgreeToTakeTest (test blood_test))
| occurred in the past, it did not indicate effort toward
\ preventing (Doctor PositivelyIdentifyIllness (illness intestinal_infection)).
/ The system is not aware of Doctor
\ expending effort to prevent this event.
Doctor feeling medium-low FEARS-CONFIRMED appears to be evident.

Looking at the mood, we can also see that the doctor was self-satisfied over his success at diagnosing the illness. Another emotion that occurred in this scenario run through was the doctor feeling sorry for the patient for having to endure the pain of involved in extracting blood:

***** DOCTOR'S EMOTIONS to: Doctor> ExpressSideEffectOfTest (minor_pain)

----- Episodes ----->
Medium SORRY-FOR associated with
the Patient's desire to AvoidPain.
...no agent emotion...
...no object emotion...

----- Mood ----->
Medium SORRY-FOR associated with
the Patient's desire to AvoidPain.
...no agent emotion...
Medium DISLIKING for Doctor

----- Dispositions in Focus ----->
...no event emotion...
Medium-high PRIDE towards Doctor
Medium-low DISLIKING for minor_pain

In the analysis of the sorry-for emotion, note that because there were no specific EventJusticeLinks involved, the model assumed that the doctor would have no reason to feel that distress on the part of the patient was justified. Thus, proving that distress was evident proved that the event was undeserved.

Considering SORRY-FOR of the Doctor...
/ The Doctor has focused on
\ (Doctor ExpressSideEffectOfTest (side_effect minor_pain)) as an event.
/ The Patient feels the goal 'AvoidPain'
\ has been inhibited to a medium-low degree.
/ The Patient believes AvoidPain
\ is desirable to a medium degree.
< The Doctor does not believe a personal goal has been inhibited.
< The Doctor believes if the Patient feels DISTRESS, it is undeserved.

Considering DISTRESS of the Patient...
/ The Patient has focused on
\ (Doctor ExpressSideEffectOfTest (side_effect minor_pain)) as an event.

/ The Patient feels the goal 'AvoidPain'
\ has been inhibited to a medium-low degree.
/ The Patient believes AvoidPain
\ is desirable to a medium degree.
Patient feeling medium DISTRESS appears to be evident.

```
/ The Doctor feels the Patient is undeserving of the prospect  
| implied by (Doctor ExpressSideEffectOfTest (side_effect minor_pain)) to  
\ a medium degree.  
/ The Doctor has a disposition of liking the  
\ Patient to a medium degree.  
Doctor feeling medium SORRY-FOR appears to be evident.
```

With these examples, we have shown that our model detects basic event emotions such as distress and joy, and also prospective emotions such as fear and hope. The model remembered these prospective emotions and produced confirmation emotions such as satisfaction and fears-confirmed, as well as the disconfirmation emotion of relief. We also showed the model detected emotions with respect to the fortunes of others, as was the case with the sorry-for emotion. In the agent based focus dimension our model exhibited reproach, approval and pride. Liking and disliking were detected in the object based focus dimension. Crossing over temporal bounds, we showed the model expressing both emotional moods and dispositions.

In the next chapter, we will make some conclusions about our work, show some other test scenarios that could be constructed, and look towards ways of making the model more sophisticated.

12. Retrospection

In summary, we have constructed a computational model of human emotions that tries to detect the eliciting conditions of emotions. We have exhibited its abilities with a patient/doctor scenario interactive test case. By refining the general theoretical concepts developed by the Ortony group and Bouzid, and by determining the precise definitions of such components as constraints, moods and dispositions, we implemented a working computer model. This model detected emotions directed towards events, agents and objects, and reported emotional states from the temporal dimensions of immediate episodes, overall moods, and deep set dispositions.

We must state that there are many facets of emotions that our model does not consider, such as physiologically induced emotions, subconscious cognition and extensive past emotional histories. We do not model the mental development process of likelihood and effort perception. We do not model the dynamic creation and deletion of goals. While our model detects many more emotions than past programs, there are many emotions which it does not detect. Our constraints defining the eliciting conditions of emotions are simple; and consequently, they are not always able to discern the emotions felt in a contextual scenario. One manifestation of this limitation lies in our definition of a desirable event as an event that achieves some goal. There are

certainly desirable events that are not directly linked to goals.

We must also make clear that our model makes the assumption that each participant in the scenario knows each others' goals, and is consequently able to tell when to feel sorry-for, or happy-for, or resentment, or any of the other emotions directed towards others. In reality, people have beliefs about the goals of others, but these beliefs may be inaccurate.

We make no claims about the empirical validity of the model, however the Ortony group does mention some empirical test support. Upon examining the output, it is clear that our implementation does exhibit face validity (see Appendix B). Our goal was to provide the computer with a rudimentary ability to detect emotions, not to propose a new model of emotions for scientific study, or to model every aspect of emotions.

Other Scenarios

The general nature of the model does not restrict the type of test case used in any way. The model would certainly be able to detect emotions in cases other than the patient/doctor scenario. To show that this is true, we will consider how we could encode contextual information and detect emotions for three other scenarios in this section. None of these scenarios we will discuss here are complete, they are simply meant to express possibilities. A full blown scenario involves hundreds of acts, many more hundreds of act indicators and a very involved pragmatic "acts grammar." (The patient/doctor scenario

required 271 kilobytes of memory to represent.)

The first of these scenarios takes place between a lawyer and his or her client. Later, a judge also comes into the picture. Here are some acts that could be encoded for the scenario participants:

(Lawyer ExpressDesireToAssistClient ())
(Lawyer AskAboutCase (case <some_case>))
 where the <some_case> parameter could equal:
 car_accident, contract_breach, will_writing, police_brutality
 sexual_discrimination, product_liability, etc.

If car accident was evident then:
(Lawyer AskConditionOfCar (car <some_car>))
(Lawyer AskOwnerOfCar (car <some_car>))
(Lawyer AskAboutInsurance ())

(Client ExpressLoss (loss <some_loss>))
 where <some_loss> could equal:
 whip_lash, no_job, unpaid_fees, dead_cat, etc.
(Client ExpressInnocence ())
(Client ExpressEmotion (emotion <some_emotion>))

(Lawyer CalmClientDown ())
(Lawyer ExpressDesireToSettleOutOfCourt ())
(Lawyer ExpressDesireToSubpoena (witness <person>))
(Lawyer TellClientToFindOtherLawyer ())
(Lawyer ExpressFee (amount <some_amount>))
(Lawyer ExpressDesireToSueFor (amount <some_amount>))
(Judge AwardClient (amount <some_amount>))
and so on...

In the Act Indicators database, we would identify such acts as “CalmClientDown” as an expected conformance on the part of the lawyer. Whereas, “TellClientToFind OtherLawyer” would constitute an expected

nonconformance, or perhaps from the client's point of view, an obligatory nonconformance. These features would promote the detection of agent and (human) object based emotions. We would also specify "EventToEventLinks," such as the client's linkage between the lawyer expressing the amount of claim money and the judge actually rewarding the claim money. There would be "EventToGoalLinks," such as the link between the judge's reward and the client's goal of "Becoming Rich." These kinds of links would promote event based emotions. The pragmatic "Acts Grammar," on a very superficial level, might look something like Figure 7. Each node in the figure would have a number of acts associated with it. A complete grammar would have many times more nodes. Characteristics of the participants such as the client's dispositional desire to get rich and the lawyer's low emotional persistence would be included in the Agent Characteristics database.

The next scenario is perhaps a more humorous one between some old fishermen in a bar. The idea is an old fisherman joins some other fishermen after a long day of fish catching. Here are some fishermen bar acts:

```
(Fishermanx MakeOutrageousClaim (big_claim <some_claim>))
  where <some_claim> could be:
    caught_1000_fish_today, sailed_through_hurricane,
    drank_5_bottles_of_rum, used_to_be_naval_captain, etc.
(Fishermanx DownDrink (drink <some_drink>))
(Fishermanx ExpressFishingTechnique (technique <a_technique>))
(Fishermanx DisputeBigClaim (big_claim <some_claim>))
(Fishermanx GiveDirtyLookAndSpit ())
```

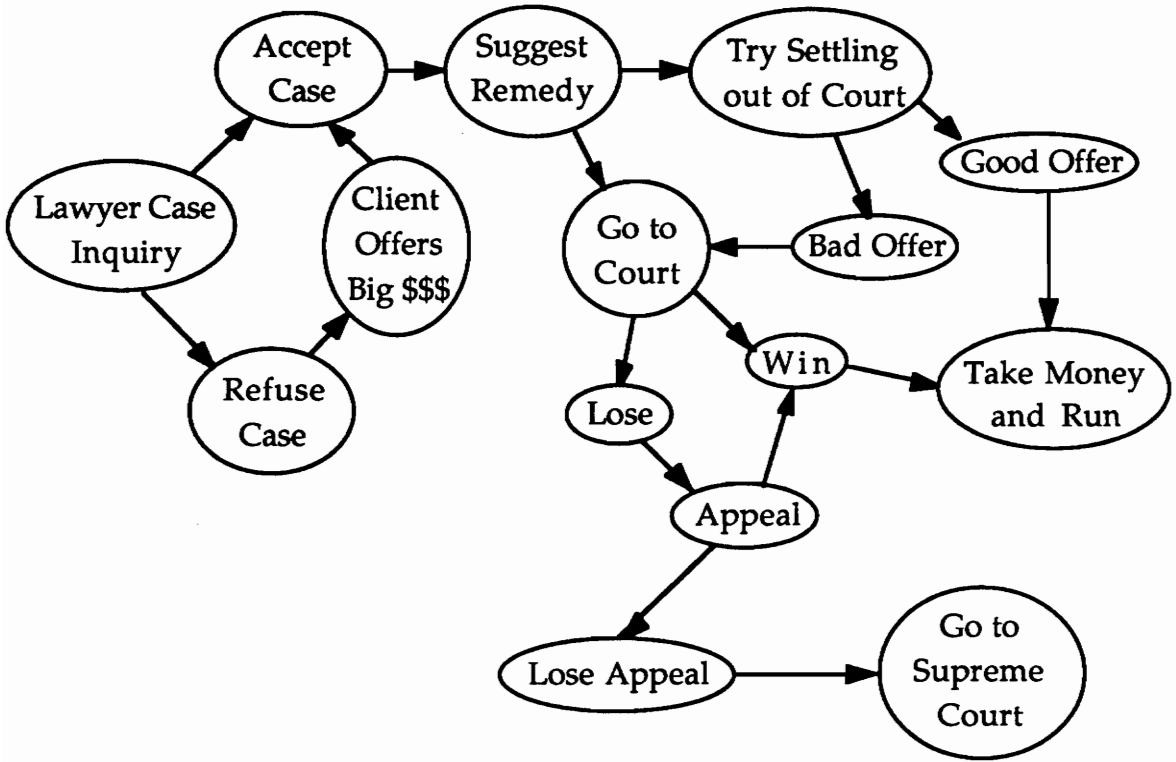


Figure 7: Simplified Acts Grammar for a Lawyer/Client/Judge Scenario

(Fisherman_x ExceedOther'sClaim (huge_claim <some_claim>))

where <some_claim> in this cause could be:

caught_1000_man-eating_sharks, sailed_through_typhoon,
drank_10_bottles_of_rot-gut, used_to_be_naval_admiral,
etc.

(Fisherman_x BreatheFumesOnOtherFisherman ())

(Fisherman_x BeImpressedByClaim ())

(Fisherman_x PretendToPassOutFromFumes ())

(Fisherman_x PunchOtherFisherman ())

etc.

The "GiveDirtyLookAndSpit" act would definitely be a mild expected nonconformance to the other fishermen. "BeImpressedByClaim" would be an expected conformance. There would be a "EventJusticeLink" asserting deservingness between "GiveDirtyLookAndSpit" to "BreatheFumesOnOtherFisherman." The greatly simplified acts grammar for this scenario might look something like Figure 8.

Another interesting scenario might take place between a computer and a user. The idea of a computer feeling emotions was discussed and presented in [Frijda and Swagerman 1987]. For such a scenario in our system, acts associated with this interaction might be:

(User AskForFile (file <some_file>))

where <some_file> could be:

money_ledger, letter_to_mom, report_for_work,
pictures_of_kids, etc.

(Computer LoadFile (file <some_file>))

(Computer HaveDifficultyLoadingFile (file <some_file>))

(Computer CrashProgram (program <some_program>))

(Computer ExplainCrashNicely ())

(Computer RecoverFromCrash ())

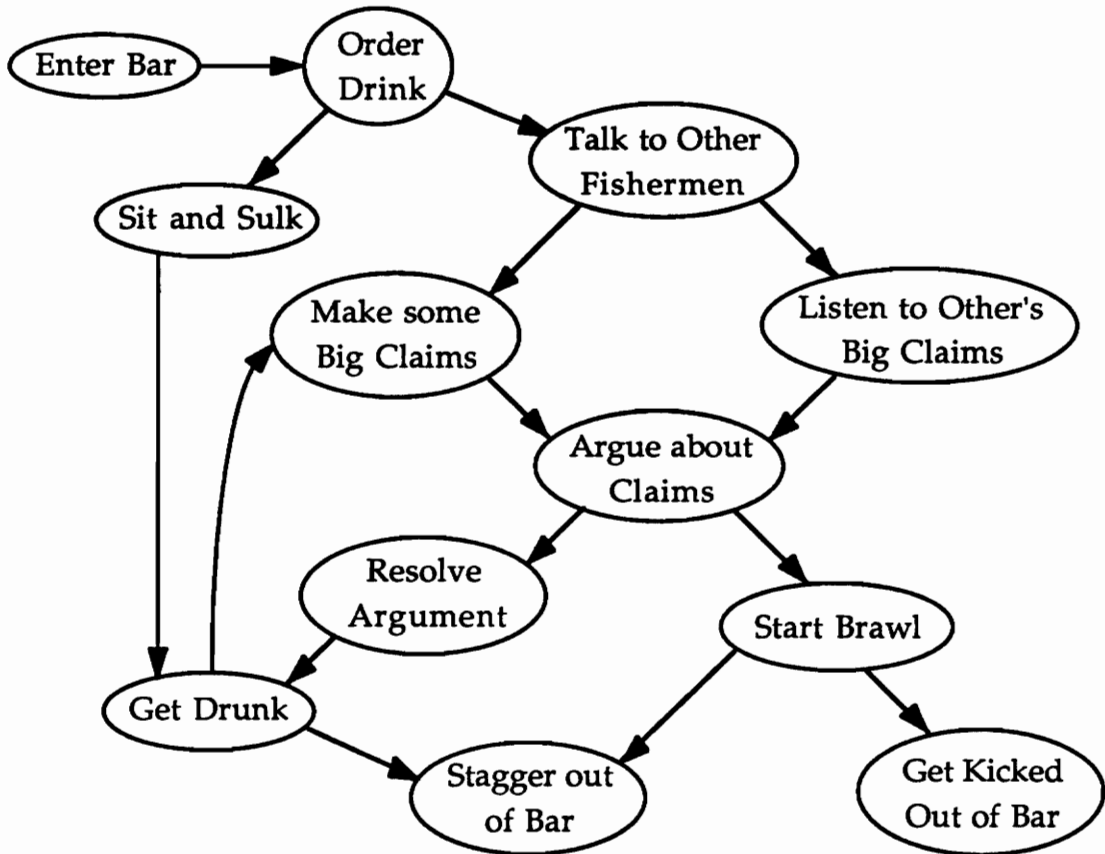


Figure 8: Simplified Acts Grammar for a Old Fishermen in Bar Scenario

(User AskForHelp ())
(User RequestFileDeletion (file <some_file>))
(Computer GiveHelpInfo (info <some_info>))
etc.

For the computer itself to have emotions, it would have to have its own goals, expectations, likes and dislikes, etc. Perhaps the computer's goals could be somewhat like those expressed in Figure 9. If the interactions between a user and a computer were much more sophisticated than they are today, a computer might take the form of a "work-mate," or an "office-mate." This interaction would involve computers communicating with employees in manager-subordinate scenario. This is similar to Arthur C. Clark's vision of how the computer "HAL" would interact with astronauts on board a space ship [Clark 1968]. HAL was related to as "just another member of the crew." HAL not only understood the emotions of the crew members, but exhibited some himself. For now, however, it is probably better for computers to understand emotions and respond more effectively as a result. For example, a computer that can tell by the user's acts that the user is distressed can provide the user with help. The computer can also help humans to understand reports, books and current events if the computer understands the emotions of the people described in these accounts.

Future Directions

The first addition that would be helpful to our model would be the ability to express more than one emotion in the same focus dimension. As we

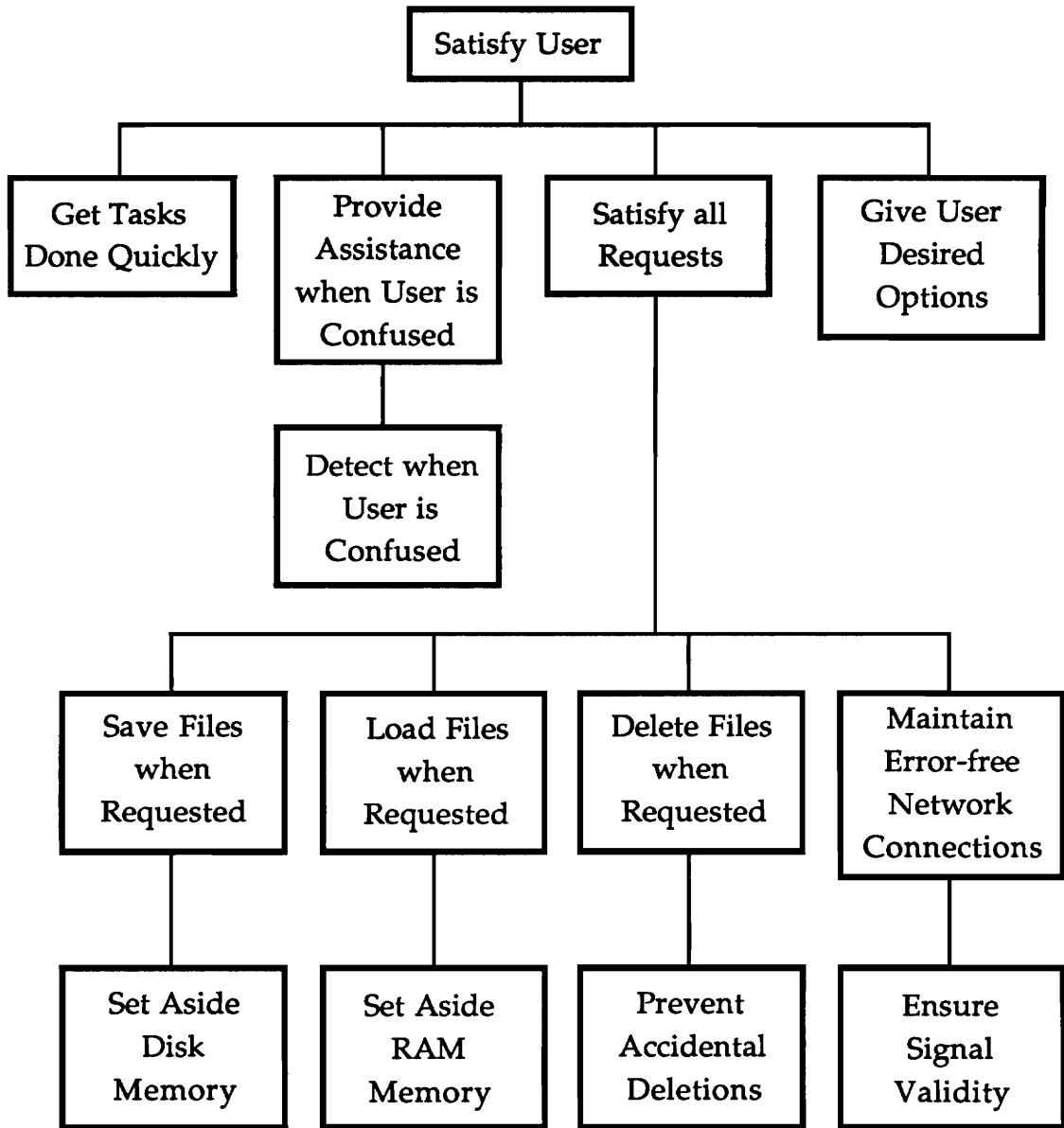


Figure 9: Simplified Goal Structure of a Computer

mentioned earlier, there are sometimes more than one goal link and event link for the same act and the same person. Sometimes the act will inhibit one goal and achieve another. This phenomenon leads to “mixed emotions.” There may also be multiple agents connected with an act, such as when the doctor’s medication prescription cures the patient. The patient should consider both the medication and the doctor as agents. More than one object may also be focused on at one time as well. This leads to expanding the act syntax to allow multiple parameters. Part of this problem is solved by focusing on different events, agents, and objects through the different temporal dimensions. For example, our model can detect an episode of fear, and at the same time a mood of hope. It is clear, however, that people have multiple event, agent and object based emotions within the same temporal dimension, so it would be a worthwhile pursuit to provide our model with the capability to detect these multiple emotions.

Another interesting pursuit would be to develop a more sophisticated understanding of the object based emotions. Liking and disliking are really the minimal set of these kinds of emotions. It would also be interesting to delve deeper into the roots of appealingness and unappealingness. We looked into some of these roots when we considered the effects of agent based emotions on object emotions. Do event based emotions also have an effect on object based emotions? We need a more complete understanding of these object based roots to answer this question.

Our representation of goals was a very simple one. It allowed us to

implement a good basic implementation of event based emotions, but a more sophisticated goal structure would probably make the event base emotion detectors even more capable. The Ortony group discusses different kinds of links between goals, such as inhibitory links, necessary links, and satisfactory links. All our links are really of the satisfactory link variety. A good number of goal issues have been studied extensively by researchers interested in modeling plans on computers [Wilensky 1983]. It would be interesting to see how the technology they have developed could be applied to our model.

In a larger sense, it would be a good project to develop a program to discern the semantic and pragmatic information (that comprise the input to our model) directly from texts or conversations. This would allow goal structures to be dynamic, due to changes in scenarios and the participants' plan developments. Verbal expression technology would also be needed to set up the expectation relations. As we mentioned before, a considerable amount of general parsing technology would be involved in such a project.

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Appendix A. List of Acts and Parameters

Doctor Acts:

(Doctor AdministerFullAnesthetic ())
(Doctor AdministerTherapy (therapy <some therapy>))
(Doctor AgreeWithPatientAssessment ())
(Doctor AskAboutPreviousIllness ())
(Doctor AskIfPatientExperiencesSymptom (symptom <some symptom>))
(Doctor AskPatientForSymptoms ())
(Doctor AskSymptomSeverity (symptom <some symptom>))
(Doctor AskToExaminePatient ())
(Doctor AskToPerformProceduralFormality (formality <some formality>))
(Doctor AwakenPatient ())
(Doctor ComplyWithPatientWish ())
(Doctor DeclareCured ())
(Doctor DeclareIllnessCurable (illness <some illness>))
(Doctor DeclareIllnessIncurable (illness <some illness>))
(Doctor DeclarePatientFreeOfIllness ())
(Doctor DeclareSurgeryToBeMajor (surgery <some surgery>))
(Doctor DeclareSurgeryToBeMinor (surgery <some surgery>))
(Doctor DeclareUnableToIdentifyIllness ())
(Doctor DeclareUnableToTreatPatient ())
(Doctor DecreaseMedicationDuration (medication <some medication>))
(Doctor DecreaseSurgeryDuration (surgery <some surgery>))
(Doctor DecreaseTestDuration (medication <some medication>))
(Doctor DecreaseTherapyDuration (therapy <some therapy>))
(Doctor DefendAssessment ())
(Doctor DisagreeWithPatientAssessment ())
(Doctor DoubtTestResultAccuracy (severity <some severity>))
(Doctor ExaminePatient ())
(Doctor ExplainMedicationProcedure (discomfort <some discomfort>))
(Doctor ExplainPurposeOfMedication (medication <some medication>))
(Doctor ExplainPurposeOfSurgery (surgery <some surgery>))
(Doctor ExplainPurposeOfTest (test <some test>))
(Doctor ExplainPurposeOfTherapy (therapy <some therapy>))
(Doctor ExplainSurgeryProcedure (discomfort <some discomfort>))
(Doctor ExplainTestProcedure (discomfort <some discomfort>))

(Doctor ExplainTherapyProcedure (discomfort <some discomfort>))
 (Doctor ExpressChanceOfMedicationSuccess (chance <some chance>))
 (Doctor ExpressChanceOfSurgerySuccess (chance <some chance>))
 (Doctor ExpressChanceOfTestConclusiveness (chance <some chance>))
 (Doctor ExpressChanceOfTherapySuccess (chance <some chance>))
 (Doctor ExpressConditionImproving ())
 (Doctor ExpressConditionWorsening ())
 (Doctor ExpressEmotion (emotion <some emotion>))
 (Doctor ExpressFutureSymptom (symptom <some symptom>))
 (Doctor ExpressIllnessSeverity (severity <some severity>))
 (Doctor ExpressInabilityToDoMore ())
 (Doctor ExpressMedicationCost (amount <some amount>))
 (Doctor ExpressMedicationDuration (duration <some duration>))
 (Doctor ExpressMedicationEffect (effect <some effect>))
 (Doctor ExpressMedicationFreeOfSideEffects ())
 (Doctor ExpressMoreCanBeDone ())
 (Doctor ExpressNoAlternativeToMedication (medication <some medication>))
 (Doctor ExpressNoAlternativeToSurgery (surgery <some surgery>))
 (Doctor ExpressNoAlternativeToTest (test <some test>))
 (Doctor ExpressNoAlternativeToTherapy (therapy <some therapy>))
 (Doctor ExpressNoMedicationAlternative (medication <some medication>))
 (Doctor ExpressNoSurgeryAlternative (surgery <some surgery>))
 (Doctor ExpressNoTherapyAlternative (therapy <some therapy>))
 (Doctor ExpressPatientFreeOfIllness ())
 (Doctor ExpressPatientsIllness (illness <some illness>))
 (Doctor ExpressRecoveryChance (chance <some chance>))
 (Doctor ExpressRecoveryStatus (status <some status>))
 (Doctor ExpressRecoveryTime (time <some time>))
 (Doctor ExpressSideEffectOfMedication (side_effect <some side_effect>))
 (Doctor ExpressSideEffectOfSurgery (side_effect <some side_effect>))
 (Doctor ExpressSideEffectOfTest (side_effect <some side_effect>))
 (Doctor ExpressSideEffectOfTherapy (side_effect <some side_effect>))
 (Doctor ExpressSurgeryCost (amount <some amount>))
 (Doctor ExpressSurgeryDuration (duration <some duration>))
 (Doctor ExpressSurgeryEffect (effect <some effect>))
 (Doctor ExpressSurgeryFreeOfSeriousSideEffects (surgery <some surgery>))
 (Doctor ExpressTestCost (amount <some amount>))
 (Doctor ExpressTestDuration (duration <some duration>))
 (Doctor ExpressTestFreeOfSideEffects (test <some test>))
 (Doctor ExpressTestResult (result <some result>))
 (Doctor ExpressTherapyCost (amount <some amount>))
 (Doctor ExpressTherapyDuration (duration <some duration>))

(Doctor ExpressTherapyEffect (effect <some effect>))
 (Doctor ExpressTherapyFreeOfSideEffects (therapy <some therapy>))
 (Doctor FailToSupressPain ())
 (Doctor FinishExamination ())
 (Doctor FinishSurgery (surgery <some surgery>))
 (Doctor FinishTest (test <some test>))
 (Doctor GiveCheckUp ())
 (Doctor ImploreToContinueMedication (medication <some medication>))
 (Doctor ImploreToContinueTest (test <some test>))
 (Doctor ImploreToContinueTherapy (therapy <some therapy>))
 (Doctor ImploreToHaveSurgery (surgery <some surgery>))
 (Doctor ImploreToTakeMedication (medication <some medication>))
 (Doctor ImploreToTakeTest (test <some test>))
 (Doctor ImploreToTakeTherapy (therapy <some therapy>))
 (Doctor IncreaseMedicationDuration (medication <some medication>))
 (Doctor IncreaseSurgeryDuration (surgery <some surgery>))
 (Doctor IncreaseTestDuration (test <some test>))
 (Doctor IncreaseTherapyDuration (therapy <some therapy>))
 (Doctor KickPatientOut ())
 (Doctor PartlyExaminePatient ())
 (Doctor PerformSurgeryPreparations ())
 (Doctor PositivelyIdentifyIllness (illness <some illness>))
 (Doctor PraiseMedication (medication <some medication>))
 (Doctor PraisePatient (severity <some severity>))
 (Doctor PraiseSurgery ())
 (Doctor PraiseTherapy (therapy <some therapy>))
 (Doctor PrescribeMedication (medication <some medication>))
 (Doctor PrescribeTherapy (therapy <some therapy>))
 (Doctor ProceedSuccessfully ())
 (Doctor ProceedUnsuccessfully ())
 (Doctor RefuseToComplyWithPatientWish ())
 (Doctor RefuseToTreatPatient ())
 (Doctor RejectMedication (medication <some medication>))
 (Doctor RejectTherapy (therapy <some therapy>))
 (Doctor RestartMedication (medication <some medication>))
 (Doctor RestartTest (test <some test>))
 (Doctor RestartTherapy (therapy <some therapy>))
 (Doctor ShowExtraKindness (severity <some severity>))
 (Doctor ShowExtraPatience (severity <some severity>))
 (Doctor ShowLackOfKindness (severity <some severity>))
 (Doctor ShowLackOfPatience (severity <some severity>))
 (Doctor StartTest (test <some test>))
 (Doctor SuggestAlternateDoctor ())

(Doctor SuggestAlternativeMedication (medication <some medication>))
 (Doctor SuggestAlternativeSurgery (surgery <some surgery>))
 (Doctor SuggestAlternativeTest (test <some test>))
 (Doctor SuggestAlternativeTherapy (therapy <some therapy>))
 (Doctor SuggestGettingSecondOpinion ())
 (Doctor SuggestMedicationAlternativeToSurgery (medication <some medication>))
 (Doctor SuggestMedicationAlternativeToTherapy (medication <some medication>))
 (Doctor SuggestSeekTreatmentElsewhere ())
 (Doctor SuggestSurgery (surgery <some surgery>))
 (Doctor SuggestSurgeryAlternativeToMedication (surgery <some surgery>))
 (Doctor SuggestSurgeryAlternativeToTherapy (surgery <some surgery>))
 (Doctor SuggestTest (test <some test>))
 (Doctor SuggestTherapyAlternativeToMedication (therapy <some therapy>))
 (Doctor SuggestTherapyAlternativeToSurgery (therapy <some therapy>))
 (Doctor SuppressPain ())
 (Doctor TakeLeaveOfPatient ())
 (Doctor UnpositivelyIdentifyIllness (illness <some illness>))
 (Doctor WaveProceduralFormality (formality <some formality>))

Patient Acts:

(Patient AdmitToHavingPreviousIllness (illness <some illness>))
 (Patient AgreeToHaveSurgery (surgery <some surgery>))
 (Patient AgreeToTakeMedication (medication <some medication>))
 (Patient AgreeToTakeTest (test <some test>))
 (Patient AgreeToTherapy (therapy <some therapy>))
 (Patient AgreeWithDoctorAssessment ())
 (Patient AllowSelfToBeExamined ())
 (Patient AskAboutFutureSymptom ())
 (Patient AskAboutMedicationProcedure (medication <some medication>))
 (Patient AskAboutMedicationSideEffects (medication <some medication>))
 (Patient AskAboutSurgeryProcedure (surgery <some surgery>))
 (Patient AskAboutSurgerySideEffects (surgery <some surgery>))
 (Patient AskAboutTestProcedure (test <some test>))
 (Patient AskAboutTestSideEffects (test <some test>))
 (Patient AskAboutTherapyProcedure (therapy <some therapy>))
 (Patient AskAboutTherapySideEffects (therapy <some therapy>))
 (Patient AskChanceOfMedicationSuccess (medication <some medication>))
 (Patient AskChanceOfSurgerySuccess (surgery <some surgery>))

(Patient AskChanceOfTestConclusiveness (test <some test>))
 (Patient AskChanceOfTherapySuccess (therapy <some therapy>))
 (Patient AskDurationOfMedication (medication <some medication>))
 (Patient AskDurationOfSurgery (surgery <some surgery>))
 (Patient AskDurationOfTest (test <some test>))
 (Patient AskDurationOfTherapy (therapy <some therapy>))
 (Patient AskForAlternativeMedication (medication <some medication>))
 (Patient AskForAlternativeSurgery (surgery <some surgery>))
 (Patient AskForAlternativeTest (test <some test>))
 (Patient AskForAlternativeTherapy (therapy <some therapy>))
 (Patient AskForAlternativeToMedication (medication <some medication>))
 (Patient AskForAlternativeToSurgery (surgery <some surgery>))
 (Patient AskForAlternativeToTherapy (therapy <some therapy>))
 (Patient AskForMedication (medication <some medication>))
 (Patient AskForMedicationEffect ())
 (Patient AskForSurgery (surgery <some surgery>))
 (Patient AskForSurgeryEffect ())
 (Patient AskForTest (test <some test>))
 (Patient AskForTestResult ())
 (Patient AskForTherapy (therapy <some therapy>))
 (Patient AskForTherapyEffect ())
 (Patient AskMedicationCost (medication <some medication>))
 (Patient AskPurposeOfMedication (medication <some medication>))
 (Patient AskPurposeOfSurgery (surgery <some surgery>))
 (Patient AskPurposeOfTest (test <some test>))
 (Patient AskPurposeOfTherapy (therapy <some therapy>))
 (Patient AskRecoveryStatus ())
 (Patient AskSurgeryCost (surgery <some surgery>))
 (Patient AskTestCost (test <some test>))
 (Patient AskTherapyCost (therapy <some therapy>))
 (Patient AskToAdministerTest (test <some test>))
 (Patient AskToBeCuredOfIllness (illness <some illness>))
 (Patient AskToHaveSurgery (surgery <some surgery>))
 (Patient AskToIdentifyIllness ())
 (Patient AskforCheckUp ())
 (Patient ComplainAboutMedication (medication <some medication>))
 (Patient ComplainAboutSurgery (surgery <some surgery>))
 (Patient ComplainAboutTest (test <some test>))
 (Patient ComplainAboutTherapy (therapy <some therapy>))
 (Patient CurseDoctor ())
 (Patient DenyHavingPreviousIllness (illness <some illness>))
 (Patient Dies ())
 (Patient DisagreeWithDoctorAssessment ())

(Patient DoingPoorlyUnderSurgery ())
 (Patient DoingWellUnderSurgery ())
 (Patient ExpressAllSymptomsExpressed ())
 (Patient ExpressConditionImproving ())
 (Patient ExpressConditionWorsening ())
 (Patient ExpressCured ())
 (Patient ExpressDesireForSecondOpinion ())
 (Patient ExpressEffectOfPreviousMedication (effect <some effect>))
 (Patient ExpressEffectOfPreviousSurgery (effect <some effect>))
 (Patient ExpressEffectOfPreviousTherapy (effect <some effect>))
 (Patient ExpressEmotion (emotion <some emotion>))
 (Patient ExpressIllness (illness <some illness>))
 (Patient ExpressMedicationEffect (effect <some effect>))
 (Patient ExpressPain (severity <some severity>))
 (Patient ExpressPreviousIllness (illness <some illness>))
 (Patient ExpressPreviousMedication (medication <some medication>))
 (Patient ExpressPreviousSurgery (surgery <some surgery>))
 (Patient ExpressPreviousTest (test <some test>))
 (Patient ExpressPreviousTherapy (therapy <some therapy>))
 (Patient ExpressResultOfPreviousTest (result <some result>))
 (Patient ExpressSideEffectOfMedication (side_effect <some side_effect>))
 (Patient ExpressSideEffectOfSurgery (side_effect <some side_effect>))
 (Patient ExpressSideEffectOfTest (side_effect <some side_effect>))
 (Patient ExpressSideEffectOfTherapy (side_effect <some side_effect>))
 (Patient ExpressSurgeryEffect (effect <some effect>))
 (Patient ExpressSymptom (symptom <some symptom>))
 (Patient ExpressSymptomSeverity (severity <some severity>))
 (Patient ExpressTherapyEffect (effect <some effect>))
 (Patient FinishMedication (medication <some medication>))
 (Patient FinishTherapy (therapy <some therapy>))
 (Patient PerformProceduralFormality (formality <some formality>))
 (Patient PerformTherapy (therapy <some therapy>))
 (Patient PleadToBeCured ())
 (Patient PraiseDoctor (severity <some severity>))
 (Patient PraiseMedication (severity <some severity>))
 (Patient PraiseSurgery (severity <some severity>))
 (Patient PraiseTherapy (severity <some severity>))
 (Patient QuestionTestResultAccuracy (severity <some severity>))
 (Patient RefuseMedication (medication <some medication>))
 (Patient RefuseSurgery (surgery <some surgery>))
 (Patient RefuseTest (test <some test>))
 (Patient RefuseTherapy (therapy <some therapy>))
 (Patient RefuseToContinueMedication (medication <some medication>))

(Patient RefuseToContinueTest (test <some test>))
(Patient RefuseToContinueTherapy (therapy <some therapy>))
(Patient RefuseToPerformProceduralFormality (formality <some formality>))
(Patient RespondsNoIDontHaveSymptom (symptom <some symptom>))
(Patient RespondsYesIHaveSymptom (symptom <some symptom>))
(Patient ShowExtraPatience (severity <some severity>))
(Patient ShowLackOfPatience (severity <some severity>))
(Patient TakeLeaveOfDoctor ())
(Patient TakeMedication (medication <some medication>))
(Patient ThankDoctor (severity <some severity>))

Parameters:

symptom <- (runny_nose, coughing, stomach_pain, head_aches,
fainting_spells, memory_loss)

severity <- (minor, considerable, great)

emotion <- (joy, distress, desire, fear, satisfaction, disappointment,
fears_confirmed, relief, happy_for, sorry_for, resentment,
gloating, spite, hope, despair, dread, aspiration, pride, shame,
approval, reproach, liking, disliking, gratitude, anger, self-
satisfaction, remorse, coveting)

illness <- (cold, intestinal_infection, brain_cancer)

formality <- (fillout_form, remove_clothing, check_into_hospital)

amount <- (nominal, considerable, exorbitant)

medication <- (nose_drops, antibiotic, chemo_therapy)

effect <- (beneficial, non_evident, detrimental)

side_effect <- (minor_bleeding, dizziness, weakness, vomiting,
minor_pain, drowsiness, loss_of_hair,
vulnerable_to_infection, stiff_muscles)

therapy <- (chicken_soup, bed_rest, excersize, religion)

```
surgery <- (intestinal_ectomy, brain_surgery)
test <- (blood_test, X_ray, CAT_scan, EKG)
result <- (positive, inconclusive, negative)
discomfort <- (minor, considerable, great)
duration <- (insignificant, short, medium, long, lifetime)
chance <- (no_chance, improbable, fifty_fifty, probable, assured)
time <- (immediately, soon, later, much_later, never)
status <- (faster_than_expected, as_expected, slower_than_expected)
```

Appendix B. Complete Patient-Doctor Meeting with Analysis

In this appendix, we present a complete scenario run-through, starting from the patient coming to the doctor and expressing a symptom, to the cure of the patient's illness and the patient leaving the doctor. For the sake of brevity, only the analyses of successful emotion detectors are shown. In each case, however, all the event emotions, agent emotions, and object emotions are checked until an emotion in the given dimension is found. First we will show the list of the acts of the run-through, and then the model's evaluations of the emotional states of the scenario participants in response to the acts will follow.

1. (Patient ExpressSymptom (symptom head_aches))
2. (Doctor AskSymptomSeverity (symptom head_aches))
3. (Patient ExpressSymptomSeverity (severity great))
4. (Patient ExpressAllSymptomsExpressed ())
5. (Doctor ExaminePatient ())
6. (Doctor FinishExamination ())
7. (Doctor UnpositivelyIdentifyIllness (illness brain_cancer))
8. (Doctor SuggestTest (test CAT_scan))
9. (Patient AgreeToTakeTest (test CAT_scan))
10. (Doctor StartTest (test CAT_scan))
11. (Doctor FinishTest (test CAT_scan))
12. (Doctor ExpressTestResul (result positive))
13. (Doctor PositivelyIdentifyIllness (illness brain_cancer))
14. (Doctor PrescribeMedication (medication chemo_therapy))
15. (Patient AgreeToTakeMedication (medication chemo_therapy))
16. (Patient TakeMedication (medication chemo_therapy))
17. (Patient FinishMedication (medication chemo_therapy))
18. (Doctor ExpressMedicationEffect (effect beneficial))
19. (Doctor DeclarePatientFreeOfIllness ())

- 20. (Patient ThankDoctor (severity great))
- 21. (Patient TakeLeaveOfDoctor ())

******* DOCTOR'S EMOTIONS to: Patient> ExpressSymptom (head_aches)**

----- Episodes ----->

Medium-high HOPE associated with
the Doctor's desire to CureThePatientsDetectableAilments.
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high HOPE associated with
the Doctor's desire to CureThePatientsDetectableAilments.
...no agent emotion...
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
...no agent emotion...
Medium DISLIKING for head_aches

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering HOPE of the Doctor...
/ The Doctor has focused on
\ (Patient ExpressSymptom (symptom head_aches)) as an event.
/ The Doctor is now looking forward to the
| event (Doctor DeclareCured ()).
| If this event occurs, it will achieve the Doctor's
\ goal of 'CureThePatientsDetectableAilments' to a high degree.
/ The Doctor believes CureThePatientsDetectableAilments
\ is desirable to a medium degree.
/ The Doctor thinks the likelihood of the future
| event (Doctor DeclareCured ()) occurring
\ is medium-low.
Doctor feeling medium-high HOPE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:
< There was no previous mood so the HOPE episode became the mood.
< This mood has 40 potential life points.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 8 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Doctor's medium DISLIKING
\ toward head_aches surfaced.

***** PATIENT'S EMOTIONS to: Patient> ExpressSymptom (head_aches)

----- Episodes ----->

Medium-high HOPE associated with
the Patient's desire to HaveDetectedAilmentsCured.
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high HOPE associated with
the Patient's desire to HaveDetectedAilmentsCured.
Low PRIDE towards Patient
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
...no agent emotion...
Medium-high DISLIKING for head_aches

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering HOPE of the Patient...

/ The Patient has focused on
\ (Patient ExpressSymptom (symptom head_aches)) as an event.
/ The Patient is now looking forward to the
| event (Doctor DeclareCured ()).
| If this event occurs, it will achieve the Patient's
\ goal of 'HaveDetectedAilmentsCured' to a medium-high degree.
/ The Patient believes HaveDetectedAilmentsCured
\ is desirable to a medium-high degree.
/ The Patient thinks the likelihood of the future
| event (Doctor DeclareCured ()) occurring
\ is medium-low.
Patient feeling medium-high HOPE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old DISTRESS mood had a potential of 5 life points left.

| The HOPE episode had a potential of 40 life points.
\ Consequently, the episode was more pervasive.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 8 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of PRIDE.
< This mood has 5 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 1 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Patient's medium-high DISLIKING
\ toward head_aches surfaced.

**** DOCTOR'S EMOTIONS to: Doctor> AskSymptomSeverity (head_aches)

----- Episodes ----->

...no event emotion...
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high HOPE associated with
the Doctor's desire to CureThePatientsDetectableAilments.
...no agent emotion...
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
Medium PRIDE towards Doctor
Medium DISLIKING for head_aches

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

< There was no episode to effect the current mood of HOPE.
< This mood has 35 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 7 time units.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning AGENTS:

< There is no agent episode to effect a disposition.
/ The Doctor's medium PRIDE
\ toward Doctor surfaced.

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Doctor's medium DISLIKING
\ toward head_aches surfaced.

**** PATIENT'S EMOTIONS to: Doctor> AskSymptomSeverity (head_aches)

----- Episodes ----->

...no event emotion...
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high HOPE associated with
the Patient's desire to HaveDetectedAilmentsCured.
...no agent emotion...
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
Low APPROVAL towards Doctor
Medium-high DISLIKING for head_aches

::::: MOOD ANALYSIS :::::::::::::::>

For the EVENT_MOOD:

< There was no episode to effect the current mood of HOPE.
< This mood has 35 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 7 time units.

For the AGENT_MOOD:

< The mood died out.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning AGENTS:

< There is no agent episode to effect a disposition.
/ The Patient's low APPROVAL
\ toward Doctor surfaced.

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Patient's medium-high DISLIKING
\ toward head_aches surfaced.

***** DOCTOR'S EMOTIONS to: Patient> ExpressSymptomSeverity (great)

----- Episodes ----->

Medium-high HOPE associated with
the Doctor's desire to CureThePatientsDetectableAilments.
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high HOPE associated with
the Doctor's desire to CureThePatientsDetectableAilments.
...no agent emotion...
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
...no agent emotion...
...no object emotion...

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering HOPE of the Doctor...

/ The Doctor has focused on
\ (Patient ExpressSymptomSeverity (severity great)) as an event.
/ The Doctor is now looking forward to the
| event (Doctor DeclareCured ()).
| If this event occurs, it will achieve the Doctor's
\ goal of 'CureThePatientsDetectableAilments' to a high degree.
/ The Doctor believes CureThePatientsDetectableAilments
\ is desirable to a medium degree.
/ When (Patient ExpressSymptom (symptom head_aches))
| occurred in the past, it reduced the likelihood
\ of (Doctor DeclareCured ()) occurring.
/ The Doctor thinks the likelihood of the future
| event (Doctor DeclareCured ()) occurring
\ is low.
/ The Doctor's complementary mood caused this episode's
\ degree to be increased from medium to medium-high.
Doctor feeling medium-high HOPE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- / The old HOPE mood had a potential of 30 life points left.
- | The HOPE episode had a potential of 40 life points.
- \ Consequently, the episode was more pervasive.
- / The old mood and episode were complementary.
- \ This caused the new mood's life points to be increased to 50.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 10 time units.

***** PATIENT'S EMOTIONS to: Patient> ExpressSymptomSeverity (great)

----- Episodes ----->

High HOPE associated with
the Patient's desire to HaveDetectedAilmentsCured.

...no agent emotion...

...no object emotion...

----- Mood ----->

High HOPE associated with
the Patient's desire to HaveDetectedAilmentsCured.

...no agent emotion...

...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...

...no agent emotion...

...no object emotion...

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering HOPE of the Patient...

- / The Patient has focused on
- \ (Patient ExpressSymptomSeverity (severity great)) as an event.
- / The Patient is now looking forward to the
- | event (Doctor DeclareCured ()).
- | If this event occurs, it will achieve the Patient's
- \ goal of 'HaveDetectedAilmentsCured' to a medium-high degree.
- / The Patient believes HaveDetectedAilmentsCured
- \ is desirable to a medium-high degree.
- / When (Patient ExpressSymptom (symptom head_aches))
- | occurred in the past, it reduced the likelihood
- \ of (Doctor DeclareCured ()) occurring.
- / The Patient thinks the likelihood of the future
- | event (Doctor DeclareCured ()) occurring
- \ is low.
- / The Patient's complementary mood caused this episode's

\ degree to be increased from medium-high to high.
Patient feeling high HOPE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old HOPE mood had a potential of 30 life points left.
| The HOPE episode had a potential of 50 life points.
\ Consequently, the episode was more pervasive.
/ The old mood and episode were complementary.
\ This caused the new mood's life points to be increased to 60.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 12 time units.

**** DOCTOR'S EMOTIONS to: Patient> ExpressAllSymptomsExpressed

----- Episodes ----->

High HOPE associated with
the Doctor's desire to CureThePatientsDetectableAilments.
...no agent emotion...
...no object emotion...

----- Mood ----->

High HOPE associated with
the Doctor's desire to CureThePatientsDetectableAilments.
...no agent emotion...
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
...no agent emotion...
...no object emotion...

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering HOPE of the Doctor...

/ The Doctor has focused on
\ (Patient ExpressAllSymptomsExpressed ()) as an event.
/ The Doctor is now looking forward to the
| event (Doctor DeclareCured ()).
| If this event occurs, it will achieve the Doctor's
\ goal of 'CureThePatientsDetectableAilments' to a high degree.
/ The Doctor believes CureThePatientsDetectableAilments
\ is desirable to a medium degree.
/ When (Patient ExpressSymptom (symptom head_aches))
| occurred in the past, it reduced the likelihood
\ of (Doctor DeclareCured ()) occurring.

/ When (Patient ExpressSymptomSeverity (severity great))
| occurred in the past, it reduced the likelihood
\ of (Doctor DeclareCured ()) occurring.
/ The Doctor thinks the likelihood of the future
| event (Doctor DeclareCured ()) occurring
\ is medium-low.
/ The Doctor's complementary mood caused this episode's
\ degree to be increased from medium-high to high.
Doctor feeling high HOPE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old HOPE mood had a potential of 45 life points left.
| The HOPE episode had a potential of 50 life points.
\ Consequently, the episode was more pervasive.
/ The old mood and episode were complementary.
\ This caused the new mood's life points to be increased to 60.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 12 time units.

***** PATIENT'S EMOTIONS to: Patient> ExpressAllSymptomsExpressed

----- Episodes ----->

High HOPE associated with
the Patient's desire to HaveDetectedAilmentsCured.
...no agent emotion...
...no object emotion...

----- Mood ----->

High HOPE associated with
the Patient's desire to HaveDetectedAilmentsCured.
...no agent emotion...
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
...no agent emotion...
...no object emotion...

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering HOPE of the Patient...

/ The Patient has focused on
\ (Patient ExpressAllSymptomsExpressed ()) as an event.
/ The Patient is now looking forward to the

| event (Doctor DeclareCured ()).
 | If this event occurs, it will achieve the Patient's
 \ goal of 'HaveDetectedAilmentsCured' to a medium-high degree.
 / The Patient believes HaveDetectedAilmentsCured
 \ is desirable to a medium-high degree.
 / When (Patient ExpressSymptom (symptom head_aches))
 | occurred in the past, it reduced the likelihood
 \ of (Doctor DeclareCured ()) occurring.
 / When (Patient ExpressSymptomSeverity (severity great))
 | occurred in the past, it reduced the likelihood
 \ of (Doctor DeclareCured ()) occurring.
 / The Patient thinks the likelihood of the future
 | event (Doctor DeclareCured ()) occurring
 \ is medium-low.
 / The Patient's complementary mood caused this episode's
 \ degree to be increased from medium-high to high.
 Patient feeling high HOPE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:
 / The old HOPE mood had a potential of 55 life points left.
 | The HOPE episode had a potential of 50 life points.
 \ Consequently, the old mood was more pervasive.
 / The old mood and episode were complementary.
 \ This caused the new mood's life points to be increased to 65.
 / Each time unit, the mood's life points are reduced by 5.
 | (This is implied by the Patient's MEDIUM emotional persistence.)
 \ Consequently, this mood has a maximum potential lifetime of 13 time units.

**** DOCTOR'S EMOTIONS to: Doctor> ExaminePatient

----- Episodes ----->

...no event emotion...
 ...no agent emotion...
 ...no object emotion...

----- Mood ----->

High HOPE associated with
 the Doctor's desire to CureThePatientsDetectableAilments.
 ...no agent emotion...
 ...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
 Medium PRIDE towards Doctor
 Medium LIKING for Patient

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- < There was no episode to effect the current mood of HOPE.
- < This mood has 55 life points left.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 11 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

- < There is no agent episode to effect a disposition.
- / The Doctor's medium PRIDE
- \ toward Doctor surfaced.

Concerning OBJECTS:

- < There is no object episode to effect a disposition.
- / The Doctor's medium LIKING
- \ toward Patient surfaced.

******* PATIENT'S EMOTIONS to: Doctor> ExaminePatient**

----- Episodes ----->

- ...no event emotion...
- ...no agent emotion...
- ...no object emotion...

----- Mood ----->

- High HOPE associated with the Patient's desire to HaveDetectedAilmentsCured.
- ...no agent emotion...
- ...no object emotion...

----- Dispositions in Focus ----->

- ...no event emotion...
- Low APPROVAL towards Doctor
- Medium LIKING for Doctor

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- < There was no episode to effect the current mood of HOPE.
- < This mood has 60 life points left.
- / Each time unit, the mood's life points are reduced by 5.

| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 12 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

< There is no agent episode to effect a disposition.
/ The Patient's low APPROVAL
\ toward Doctor surfaced.

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Patient's medium LIKING
\ toward Doctor surfaced.

**** DOCTOR'S EMOTIONS to: Doctor> FinishExamination

----- Episodes ----->

Medium JOY associated with
the Doctor's desire to PerformCheckUp.
...no agent emotion...
...no object emotion...

----- Mood ----->

High HOPE associated with
the Doctor's desire to CureThePatientsDetectableAilments.
...no agent emotion...
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
Medium PRIDE towards Doctor
...no object emotion...
There is a disposition/episode compound emotion of medium SELF_SATISFACTION.

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering JOY of the Doctor...

/ The Doctor has focused on
\ (Doctor FinishExamination ()) as an event.
/ The Doctor feels the goal 'PerformCheckUp'
\ has been achieved to a high degree.
/ The Doctor believes PerformCheckUp
\ is desirable to a medium-low degree.
Doctor feeling medium JOY appears to be evident.

:::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- / The old HOPE mood had a potential of 50 life points left.
- | The JOY episode had a potential of 30 life points.
- \ Consequently, the old mood was more pervasive.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 10 time units.

:::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

- < There is no agent episode to effect a disposition.
- / The Doctor's medium PRIDE
- \ toward Doctor surfaced.

******* PATIENT'S EMOTIONS to: Doctor> FinishExamination**

----- Episodes ----->

- Medium-low JOY associated with the Patient's desire to DoctorGivesCheckUp.
- ...no agent emotion...
- ...no object emotion...

----- Mood ----->

- High HOPE associated with the Patient's desire to HaveDetectedAilmentsCured.
- ...no agent emotion...
- ...no object emotion...

----- Dispositions in Focus ----->

- ...no event emotion...
- Low APPROVAL towards Doctor
- ...no object emotion...
- There is a disposition/episode compound emotion of medium-low GRATITUDE.

:::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering JOY of the Patient...

- / The Patient has focused on
- \ (Doctor FinishExamination ()) as an event.
- / The Patient feels the goal 'DoctorGivesCheckUp'
- \ has been achieved to a medium-high degree.
- / The Patient believes DoctorGivesCheckUp
- \ is desirable to a low degree.
- Patient feeling medium-low JOY appears to be evident.

:::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- / The old HOPE mood had a potential of 55 life points left.
- | The JOY episode had a potential of 20 life points.
- \ Consequently, the old mood was more pervasive.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 11 time units.

:::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

- < There is no agent episode to effect a disposition.
- / The Patient's low APPROVAL
- \ toward Doctor surfaced.

**** DOCTOR'S EMOTIONS to: Doctor> UnpositivelyIdentifyIllness (brain_cancer)

----- Episodes ----->

- Medium DREAD associated with the Doctor's desire to FindThatThePatientHasNoAilments.
- ...no agent emotion...
- ...no object emotion...

----- Mood ----->

- High HOPE associated with the Doctor's desire to CureThePatientsDetectableAilments.
- ...no agent emotion...
- ...no object emotion...

----- Dispositions in Focus ----->

- ...no event emotion...
- Medium PRIDE towards Doctor
- High DISLIKING for brain_cancer

:::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering DREAD of the Doctor...

- / The Doctor has focused on
- \ (Doctor UnpositivelyIdentifyIllness (illness brain_cancer)) as an event.
- / The Doctor is now looking forward to the
- | event (Doctor PositivelyIdentifyIllness (illness brain_cancer)).
- | If this event occurs, it will inhibit the Doctor's
- \ goal of 'FindThatThePatientHasNoAilments' to a high degree.

/ The Doctor believes FindThatThePatientHasNoAilments
 \ is desirable to a medium degree.
 / The Doctor thinks the likelihood of the future
 | event (Doctor PositivelyIdentifyIllness (illness brain_cancer)) occurring
 \ is high.
 / The Doctor's contradictory mood caused this episode's
 \ degree to be reduced from medium-high to medium.
 Doctor feeling medium DREAD appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:
 / The old HOPE mood had a potential of 45 life points left.
 | The DREAD episode had a potential of 30 life points.
 \ Consequently, the old mood was more pervasive.
 / The old mood and episode were contradictory.
 \ This caused the new mood's life points to be reduced to 15.
 / Each time unit, the mood's life points are reduced by 5.
 | (This is implied by the Doctor's MEDIUM emotional persistence.)
 \ Consequently, this mood has a maximum potential lifetime of 3 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:
 < There is no agent episode to effect a disposition.
 / The Doctor's medium PRIDE
 \ toward Doctor surfaced.

Concerning OBJECTS:
 < There is no object episode to effect a disposition.
 / The Doctor's high DISLIKING
 \ toward brain_cancer surfaced.

***** PATIENT'S EMOTIONS to: Doctor> UnpositivelyIdentifyIllness (brain_cancer)

----- Episodes ----->
 Medium-high DREAD associated with
 the Patient's desire to DetectNoAilments.
 ...no agent emotion...
 ...no object emotion...

----- Mood ----->
 High HOPE associated with
 the Patient's desire to HaveDetectedAilmentsCured.
 ...no agent emotion...
 ...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...

Low APPROVAL towards Doctor

High DISLIKING for brain_cancer

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering DREAD of the Patient...

/ The Patient has focused on

\ (Doctor UnpositivelyIdentifyIllness (illness brain_cancer)) as an event.

/ The Patient is now looking forward to the

| event (Doctor PositivelyIdentifyIllness (illness brain_cancer)).

| If this event occurs, it will inhibit the Patient's

\ goal of 'DetectNoAilments' to a high degree.

/ The Patient believes DetectNoAilments

\ is desirable to a medium-high degree.

/ The Patient thinks the likelihood of the future

| event (Doctor PositivelyIdentifyIllness (illness brain_cancer)) occurring

\ is high.

/ The Patient's contradictory mood caused this episode's

\ degree to be reduced from high to medium-high.

Patient feeling medium-high DREAD appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old HOPE mood had a potential of 50 life points left.

| The DREAD episode had a potential of 40 life points.

\ Consequently, the old mood was more pervasive.

/ The old mood and episode were contradictory.

\ This caused the new mood's life points to be reduced to 10.

/ Each time unit, the mood's life points are reduced by 5.

| (This is implied by the Patient's MEDIUM emotional persistence.)

\ Consequently, this mood has a maximum potential lifetime of 2 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

< There is no agent episode to effect a disposition.

/ The Patient's low APPROVAL

\ toward Doctor surfaced.

Concerning OBJECTS:

< There is no object episode to effect a disposition.

/ The Patient's high DISLIKING

\ toward brain_cancer surfaced.

******* DOCTOR'S EMOTIONS to: Doctor> SuggestTest (CAT_scan)**

----- Episodes ----->

Medium DREAD associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
Medium PRIDE towards Doctor
...no object emotion...

----- Mood ----->

Medium DREAD associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
Medium PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
Medium-high PRIDE towards Doctor
...no object emotion...

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering DREAD of the Doctor...

/ The Doctor has focused on
\ (Doctor SuggestTest (test CAT_scan)) as an event.
/ The Doctor is now looking forward to the
| event (Doctor PositivelyIdentifyIllness (illness brain_cancer)).
| If this event occurs, it will inhibit the Doctor's
\ goal of 'FindThatThePatientHasNoAilments' to a high degree.
/ The Doctor believes FindThatThePatientHasNoAilments
\ is desirable to a medium degree.
/ When (Doctor UnpositivelyIdentifyIllness (illness brain_cancer))
| occurred in the past, it boosted the likelihood
\ of (Doctor PositivelyIdentifyIllness (illness brain_cancer)) occurring.
/ The Doctor thinks the likelihood of the future
| event (Doctor PositivelyIdentifyIllness (illness brain_cancer)) occurring
\ is high.
/ The Doctor's contradictory mood caused this episode's
\ degree to be reduced from medium-high to medium.
Doctor feeling medium DREAD appears to be evident.

Considering PRIDE of the Doctor...

< The Doctor has focused on the Doctor as an agent.
< The Doctor feels high identification towards the Doctor.
< The Doctor holds the Doctor at high responsibility for this act.
< The Doctor believes this act to be a medium-low praiseworthy act.
Doctor feeling medium PRIDE appears to be evident.

:::: MOOD ANALYSIS ::::::::::::::>

For the EVENT_MOOD:

- / The old HOPE mood had a potential of 10 life points left.
- | The DREAD episode had a potential of 30 life points.
- \ Consequently, the episode was more pervasive.
- / The old mood and episode were contradictory.
- \ This caused the new mood's life points to be reduced to 20.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 4 time units.

For the AGENT_MOOD:

- < There was no previous mood so the PRIDE episode became the mood.
- < This mood has 30 potential life points.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 6 time units.

:::: DISPOSITION ANALYSIS ::::::::::::::>

Concerning AGENTS:

- / The Doctor's disposition of PRIDE
- | toward Doctor has been
- \ enhanced by a complementary episode.
- / The Doctor's medium-high PRIDE
- \ toward Doctor surfaced.

**** PATIENT'S EMOTIONS to: Doctor> SuggestTest (CAT_scan)

----- Episodes ----->

- ...no event emotion...
- Medium APPROVAL towards Doctor
- ...no object emotion...

----- Mood ----->

- High HOPE associated with
- the Patient's desire to HaveDetectedAilmentsCured.
- Medium APPROVAL towards Doctor
- ...no object emotion...

----- Dispositions in Focus ----->

- ...no event emotion...
- Medium-low APPROVAL towards Doctor
- ...no object emotion...

:::: EPISODE ANALYSIS ::::::::::::::>

Considering APPROVAL of the Patient...

- < The Patient has focused on the Doctor as an agent.
 - < The Patient holds the Doctor at high responsibility for this act.
 - < The Patient believes this act to be a medium-low praiseworthy act.
- Patient feeling medium APPROVAL appears to be evident.

:::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- < There was no episode to effect the current mood of HOPE.
- < This mood has 5 life points left.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 1 time units.

For the AGENT_MOOD:

- < There was no previous mood so the APPROVAL episode became the mood.
- < This mood has 30 potential life points.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 6 time units.

:::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

- / The Patient's disposition of APPROVAL
- | toward Doctor has been
- \ enhanced by a complementary episode.
- / The Patient's medium-low APPROVAL
- \ toward Doctor surfaced.

**** DOCTOR'S EMOTIONS to: Patient> AgreeToTakeTest (CAT_scan)

----- Episodes ----->

Medium-high DREAD associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high DREAD associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
Medium PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
...no agent emotion...

...no object emotion...

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering DREAD of the Doctor...

/ The Doctor has focused on
\ (Patient AgreeToTakeTest (test CAT_scan)) as an event.
/ The Doctor is now looking forward to the
| event (Doctor PositivelyIdentifyIllness (illness brain_cancer)).
| If this event occurs, it will inhibit the Doctor's
\ goal of 'FindThatThePatientHasNoAilments' to a high degree.
/ The Doctor believes FindThatThePatientHasNoAilments
\ is desirable to a medium degree.
/ When (Doctor UnpositivelyIdentifyIllness (illness brain_cancer))
| occurred in the past, it boosted the likelihood
\ of (Doctor PositivelyIdentifyIllness (illness brain_cancer)) occurring.
/ When (Doctor SuggestTest (test CAT_scan))
| occurred in the past, it did not change the likelihood
\ of (Doctor PositivelyIdentifyIllness (illness brain_cancer)) occurring.
/ The Doctor thinks the likelihood of the future
| event (Doctor PositivelyIdentifyIllness (illness brain_cancer)) occurring
\ is high.
Doctor feeling medium-high DREAD appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old DREAD mood had a potential of 15 life points left.
| The DREAD episode had a potential of 40 life points.
\ Consequently, the episode was more pervasive.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 8 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of PRIDE.
< This mood has 25 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 5 time units.

***** PATIENT'S EMOTIONS to: Patient> AgreeToTakeTest (CAT_scan)

----- Episodes ----->

Medium-high DREAD associated with
the Patient's desire to DetectNoAilments.
...no agent emotion...

...no object emotion...

----- Mood ----->

Medium-high DREAD associated with
the Patient's desire to DetectNoAilments.

Medium APPROVAL towards Doctor

...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...

...no agent emotion...

...no object emotion...

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering DREAD of the Patient...

/ The Patient has focused on

\ (Patient AgreeToTakeTest (test CAT_scan)) as an event.

/ The Patient is now looking forward to the

| event (Doctor PositivelyIdentifyIllness (illness brain_cancer)).

| If this event occurs, it will inhibit the Patient's

\ goal of 'DetectNoAilments' to a high degree.

/ The Patient believes DetectNoAilments

\ is desirable to a medium-high degree.

/ When (Doctor UnpositivelyIdentifyIllness (illness brain_cancer))

| occurred in the past, it boosted the likelihood

\ of (Doctor PositivelyIdentifyIllness (illness brain_cancer)) occurring.

/ The Patient thinks the likelihood of the future

| event (Doctor PositivelyIdentifyIllness (illness brain_cancer)) occurring

\ is high.

/ The Patient's contradictory mood caused this episode's

\ degree to be reduced from high to medium-high.

Patient feeling medium-high DREAD appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old HOPE mood had a potential of 0 life points left.

| The DREAD episode had a potential of 40 life points.

\ Consequently, the episode was more pervasive.

/ The old mood and episode were contradictory.

\ This caused the new mood's life points to be reduced to 40.

/ Each time unit, the mood's life points are reduced by 5.

| (This is implied by the Patient's MEDIUM emotional persistence.)

\ Consequently, this mood has a maximum potential lifetime of 8 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of APPROVAL.

< This mood has 25 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 5 time units.

******* DOCTOR'S EMOTIONS to: Doctor> StartTest (CAT_scan)**

----- Episodes ----->

Medium-low JOY associated with
the Doctor's desire to PerformTest.

...no agent emotion...

...no object emotion...

----- Mood ----->

Medium-high DREAD associated with
the Doctor's desire to FindThatThePatientHasNoAilments.

Medium PRIDE towards Doctor

...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...

Medium-high PRIDE towards Doctor

...no object emotion...

There is a disposition/episode compound emotion of medium SELF_SATISFACTION.

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering JOY of the Doctor...

/ The Doctor has focused on

\ (Doctor StartTest (test CAT_scan)) as an event.

/ The Doctor feels the goal 'PerformTest'

\ has been achieved to a medium-high degree.

/ The Doctor believes PerformTest

\ is desirable to a low degree.

Doctor feeling medium-low JOY appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old DREAD mood had a potential of 35 life points left.

| The JOY episode had a potential of 20 life points.

\ Consequently, the old mood was more pervasive.

/ Each time unit, the mood's life points are reduced by 5.

| (This is implied by the Doctor's MEDIUM emotional persistence.)

\ Consequently, this mood has a maximum potential lifetime of 7 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of PRIDE.
< This mood has 20 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 4 time units.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning AGENTS:

< There is no agent episode to effect a disposition.
/ The Doctor's medium-high PRIDE
\ toward Doctor surfaced.

***** PATIENT'S EMOTIONS to: Doctor> StartTest (CAT_scan)

----- Episodes ----->

Medium-low DREAD associated with
the Patient's desire to AvoidPain.
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high DREAD associated with
the Patient's desire to DetectNoAilments.
Medium APPROVAL towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

Medium FEAR associated with
the Patient's desire to AvoidPain.
Medium-low APPROVAL towards Doctor
...no object emotion...

::::: EPISODE ANALYSIS :::::::::::::::>

Considering DREAD of the Patient...

/ The Patient has focused on
\ (Doctor StartTest (test CAT_scan)) as an event.
/ The Patient is now looking forward to the
| event (Patient ExpressPain (severity minor)).
| If this event occurs, it will inhibit the Patient's
\ goal of 'AvoidPain' to a low degree.
/ The Patient believes AvoidPain
\ is desirable to a medium degree.
/ The Patient thinks the likelihood of the future
| event (Patient ExpressPain (severity minor)) occurring
\ is high.

Patient feeling medium-low DREAD appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- / The old DREAD mood had a potential of 35 life points left.
- | The DREAD episode had a potential of 20 life points.
- \ Consequently, the old mood was more pervasive.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 7 time units.

For the AGENT_MOOD:

- < There was no episode to effect the current mood of APPROVAL.
- < This mood has 20 life points left.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 4 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

- < There is no agent episode to effect a disposition.
- / The Patient's medium-low APPROVAL
- \ toward Doctor surfaced.

***** DOCTOR'S EMOTIONS to: Doctor> FinishTest (CAT_scan)

----- Episodes ----->

Medium-low JOY associated with
the Doctor's desire to PerformTest.
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high DREAD associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
Medium PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
Medium-high PRIDE towards Doctor
...no object emotion...
There is a disposition/episode compound emotion of medium SELF_SATISFACTION.

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering JOY of the Doctor...
/ The Doctor has focused on
\ (Doctor FinishTest (test CAT_scan)) as an event.
/ The Doctor feels the goal 'PerformTest'
\ has been achieved to a high degree.
/ The Doctor believes PerformTest
\ is desirable to a low degree.
Doctor feeling medium-low JOY appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:
/ The old DREAD mood had a potential of 30 life points left.
| The JOY episode had a potential of 20 life points.
\ Consequently, the old mood was more pervasive.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 6 time units.

For the AGENT_MOOD:
< There was no episode to effect the current mood of PRIDE.
< This mood has 15 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 3 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:
< There is no agent episode to effect a disposition.
/ The Doctor's medium-high PRIDE
\ toward Doctor surfaced.

**** PATIENT'S EMOTIONS to: Doctor> FinishTest (CAT_scan)

----- Episodes ----->
Medium-low RELIEF associated with
the Patient's desire to AvoidPain.
...no agent emotion...
...no object emotion...

----- Mood ----->
Medium-high DREAD associated with
the Patient's desire to DetectNoAilments.
Medium APPROVAL towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

Medium FEAR associated with
the Patient's desire to AvoidPain.
Medium-low APPROVAL towards Doctor
...no object emotion...

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering RELIEF of the Patient...
/ The Patient has focused on
\ (Doctor FinishTest (test CAT_scan)) as an event.
/ The Patient feels the goal 'AvoidPain'
\ has been achieved to a medium degree.
/ The Patient did not feel FEAR toward
\ the goal attending this event in the past.
/ The Patient previously felt medium-low DREAD focused on
\ the goal attending this event.
/ The Patient believes AvoidPain
\ is desirable to a medium degree.
/ The system is not aware of Patient
\ expending effort to prevent this event.
Patient feeling medium-low RELIEF appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:
/ The old DREAD mood had a potential of 30 life points left.
| The RELIEF episode had a potential of 20 life points.
\ Consequently, the old mood was more pervasive.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 6 time units.

For the AGENT_MOOD:
< There was no episode to effect the current mood of APPROVAL.
< This mood has 15 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 3 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning EVENTS:
/ The Patient's medium FEAR
\ toward (Patient AvoidPain) surfaced.

Concerning AGENTS:

< There is no agent episode to effect a disposition.
/ The Patient's medium-low APPROVAL
\ toward Doctor surfaced.

***** DOCTOR'S EMOTIONS to: Doctor> ExpressTestResult (positive)

----- Episodes ----->

Medium-high FEARS-CONFIRMED associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high FEARS-CONFIRMED associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
Medium PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
Medium-high PRIDE towards Doctor
...no object emotion...

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering FEARS-CONFIRMED of the Doctor...

/ The Doctor has focused on
\ (Doctor ExpressTestResult (result positive)) as an event.
/ The Doctor feels the goal 'FindThatThePatientHasNoAilments'
\ has been inhibited to a high degree.
/ The Doctor did not feel FEAR toward
\ the goal attending this event in the past.
/ The Doctor previously felt medium DREAD focused on
\ the goal attending this event.
/ The Doctor believes FindThatThePatientHasNoAilments
\ is desirable to a medium degree.
/ The system is not aware of Doctor
\ expending effort to prevent this event.
Doctor feeling medium-high FEARS-CONFIRMED appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old DREAD mood was directed toward the current event as
| a prospect. Consequently the prospect based FEARS-CONFIRMED episode
\ replaced the old mood.

< This new mood has 40 life points.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 8 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of PRIDE.
< This mood has 10 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 2 time units.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning AGENTS:

< There is no agent episode to effect a disposition.
/ The Doctor's medium-high PRIDE
\ toward Doctor surfaced.

***** PATIENT'S EMOTIONS to: Doctor> ExpressTestResult (positive)

----- Episodes ----->

High FEARS-CONFIRMED associated with
the Patient's desire to DetectNoAilments.
...no agent emotion...
...no object emotion...

----- Mood ----->

High FEARS-CONFIRMED associated with
the Patient's desire to DetectNoAilments.
Medium APPROVAL towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
Medium-low APPROVAL towards Doctor
...no object emotion...

::::: EPISODE ANALYSIS :::::::::::::::>

Considering FEARS-CONFIRMED of the Patient...

/ The Patient has focused on
\ (Doctor ExpressTestResult (result positive)) as an event.
/ The Patient feels the goal 'DetectNoAilments'
\ has been inhibited to a high degree.
/ The Patient did not feel FEAR toward
\ the goal attending this event in the past.

/ The Patient previously felt medium-high DREAD focused on
\ the goal attending this event.
/ The Patient believes DetectNoAilments
\ is desirable to a medium-high degree.
/ The system is not aware of Patient
\ expending effort to prevent this event.
Patient feeling high FEARS-CONFIRMED appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old DREAD mood was directed toward the current event as
| a prospect. Consequently the prospect based FEARS-CONFIRMED episode
\ replaced the old mood.
< This new mood has 50 life points.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 10 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of APPROVAL.
< This mood has 10 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 2 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

< There is no agent episode to effect a disposition.
/ The Patient's medium-low APPROVAL
\ toward Doctor surfaced.

***** DOCTOR'S EMOTIONS to: Doctor> PositivelyIdentifyIllness (brain_cancer)

----- Episodes ----->

High DREAD associated with
the Doctor's desire to SecureTheHealthOfTheCurrentPatient.
Medium-high PRIDE towards Doctor
...no object emotion...

----- Mood ----->

High DREAD associated with
the Doctor's desire to SecureTheHealthOfTheCurrentPatient.
Medium-high PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->
...no event emotion...
High PRIDE towards Doctor
High DISLIKING for brain_cancer

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering DREAD of the Doctor...
/ The Doctor has focused on
\ (Doctor PositivelyIdentifyIllness (illness brain_cancer)) as an event.
/ The Doctor is now looking forward to the
| event (Patient Dies ()).
| If this event occurs, it will inhibit the Doctor's
\ goal of 'SecureTheHealthOfTheCurrentPatient' to a high degree.
/ The Doctor believes SecureTheHealthOfTheCurrentPatient
\ is desirable to a medium-high degree.
/ The Doctor thinks the likelihood of the future
| event (Patient Dies ()) occurring
\ is high.
Doctor feeling high DREAD appears to be evident.

Considering PRIDE of the Doctor...
< The Doctor has focused on the Doctor as an agent.
< The Doctor feels high identification towards the Doctor.
< The Doctor holds the Doctor at high responsibility for this act.
< The Doctor believes this act to be a medium-low praiseworthy act.
/ The Doctor's complementary mood caused this episode's
\ degree to be increased from medium to medium-high.
Doctor feeling medium-high PRIDE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:
/ The old FEARS-CONFIRMED mood had a potential of 35 life points left.
| The DREAD episode had a potential of 50 life points.
\ Consequently, the episode was more pervasive.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 10 time units.

For the AGENT_MOOD:
/ The old PRIDE mood had a potential of 5 life points left.
| The PRIDE episode had a potential of 40 life points.
\ Consequently, the episode was more pervasive.
/ The old mood and episode were complementary.
\ This caused the new mood's life points to be increased to 50.
/ Each time unit, the mood's life points are reduced by 5.

| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 10 time units.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning AGENTS:

/ The Doctor's disposition of PRIDE
| toward Doctor has been
\ enhanced by a complementary episode.
/ The Doctor's high PRIDE
\ toward Doctor surfaced.

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Doctor's high DISLIKING
\ toward brain_cancer surfaced.

***** PATIENT'S EMOTIONS to: Doctor> PositivelyIdentifyIllness (brain_cancer)

----- Episodes ----->

High DREAD associated with
the Patient's desire to SecurePersonalHealth.
Medium-high APPROVAL towards Doctor
...no object emotion...

----- Mood ----->

High DREAD associated with
the Patient's desire to SecurePersonalHealth.
Medium-high APPROVAL towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

Medium-high DESIRE associated with
the Patient's desire to SecurePersonalHealth.
Medium APPROVAL towards Doctor
High DISLIKING for brain_cancer

::::: EPISODE ANALYSIS :::::::::::::::>

Considering DREAD of the Patient...

/ The Patient has focused on
\ (Doctor PositivelyIdentifyIllness (illness brain_cancer)) as an event.
/ The Patient is now looking forward to the
| event (Patient Dies ()).
| If this event occurs, it will inhibit the Patient's
\ goal of 'SecurePersonalHealth' to a high degree.
/ The Patient believes SecurePersonalHealth

\ is desirable to a high degree.
/ The Patient thinks the likelihood of the future
| event (Patient Dies ()) occurring
\ is high.
Patient feeling high DREAD appears to be evident.

Considering APPROVAL of the Patient...
< The Patient has focused on the Doctor as an agent.
< The Patient holds the Doctor at high responsibility for this act.
< The Patient believes this act to be a medium-low praiseworthy act.
/ The Patient's complementary mood caused this episode's
\ degree to be increased from medium to medium-high.
Patient feeling medium-high APPROVAL appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:
/ The old FEARS-CONFIRMED mood had a potential of 45 life points left.
| The DREAD episode had a potential of 50 life points.
\ Consequently, the episode was more pervasive.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 10 time units.

For the AGENT_MOOD:
/ The old APPROVAL mood had a potential of 5 life points left.
| The APPROVAL episode had a potential of 40 life points.
\ Consequently, the episode was more pervasive.
/ The old mood and episode were complementary.
\ This caused the new mood's life points to be increased to 50.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 10 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning EVENTS:
/ The Patient's medium-high DESIRE
\ toward (Patient SecurePersonalHealth) surfaced.

Concerning AGENTS:
/ The Patient's disposition of APPROVAL
| toward Doctor has been
\ enhanced by a complementary episode.
/ The Patient's medium APPROVAL
\ toward Doctor surfaced.

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Patient's high DISLIKING
\ toward brain_cancer surfaced.

******* DOCTOR'S EMOTIONS to: Doctor> PrescribeMedication (chemo_therapy)**

----- Episodes ----->

Medium-high JOY associated with
the Doctor's desire to PrescribeMedicine.
Medium-high PRIDE towards Doctor
...no object emotion...
This implies a compound emotion of medium-high SELF_SATISFACTION.

----- Mood ----->

High DREAD associated with
the Doctor's desire to SecureTheHealthOfTheCurrentPatient.
Medium-high PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
High PRIDE towards Doctor
Medium-high DISLIKING for chemo_therapy
There is a disposition/episode compound emotion of high SELF_SATISFACTION.

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering JOY of the Doctor...

/ The Doctor has focused on
\ (Doctor PrescribeMedication (medication chemo_therapy)) as an event.
/ The Doctor feels the goal 'PrescribeMedicine'
\ has been achieved to a high degree.
/ The Doctor believes PrescribeMedicine
\ is desirable to a medium degree.
Doctor feeling medium-high JOY appears to be evident.

Considering PRIDE of the Doctor...

< The Doctor has focused on the Doctor as an agent.
< The Doctor feels high identification towards the Doctor.
< The Doctor holds the Doctor at high responsibility for this act.
< The Doctor believes this act to be a medium-low praiseworthy act.
/ The Doctor's complementary mood caused this episode's
\ degree to be increased from medium to medium-high.
Doctor feeling medium-high PRIDE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- / The old DREAD mood had a potential of 45 life points left.
- | The JOY episode had a potential of 40 life points.
- \ Consequently, the old mood was more pervasive.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 9 time units.

For the AGENT_MOOD:

- / The old PRIDE mood had a potential of 45 life points left.
- | The PRIDE episode had a potential of 40 life points.
- \ Consequently, the old mood was more pervasive.
- / The old mood and episode were complementary.
- \ This caused the new mood's life points to be increased to 55.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 11 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

- / The Doctor's disposition of PRIDE
- | toward Doctor has been
- \ enhanced by a complementary episode.
- / The Doctor's high PRIDE
- \ toward Doctor surfaced.

Concerning OBJECTS:

- < There is no object episode to effect a disposition.
- / The Doctor's medium-high DISLIKING
- \ toward chemo_therapy surfaced.

***** PATIENT'S EMOTIONS to: Doctor> PrescribeMedication (chemo_therapy)

----- Episodes ----->

Medium-high JOY associated with
the Patient's desire to HaveMedicinePrescribed.
Medium-high APPROVAL towards Doctor
...no object emotion...
This implies a compound emotion of medium-high GRATITUDE.

----- Mood ----->

High DREAD associated with
the Patient's desire to SecurePersonalHealth.
Medium-high APPROVAL towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...

Medium-high APPROVAL towards Doctor

...no object emotion...

There is a disposition/episode compound emotion of medium-high GRATITUDE.

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering JOY of the Patient...

/ The Patient has focused on

\ (Doctor PrescribeMedication (medication chemo_therapy)) as an event.

/ The Patient feels the goal 'HaveMedicinePrescribed'

\ has been achieved to a high degree.

/ The Patient believes HaveMedicinePrescribed

\ is desirable to a medium-low degree.

Patient feeling medium-high JOY appears to be evident.

Considering APPROVAL of the Patient...

< The Patient has focused on the Doctor as an agent.

< The Patient holds the Doctor at high responsibility for this act.

< The Patient believes this act to be a medium-low praiseworthy act.

/ The Patient's complementary mood caused this episode's

\ degree to be increased from medium to medium-high.

Patient feeling medium-high APPROVAL appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old DREAD mood had a potential of 45 life points left.

| The JOY episode had a potential of 40 life points.

\ Consequently, the old mood was more pervasive.

/ Each time unit, the mood's life points are reduced by 5.

| (This is implied by the Patient's MEDIUM emotional persistence.)

\ Consequently, this mood has a maximum potential lifetime of 9 time units.

For the AGENT_MOOD:

/ The old APPROVAL mood had a potential of 45 life points left.

| The APPROVAL episode had a potential of 40 life points.

\ Consequently, the old mood was more pervasive.

/ The old mood and episode were complementary.

\ This caused the new mood's life points to be increased to 55.

/ Each time unit, the mood's life points are reduced by 5.

| (This is implied by the Patient's MEDIUM emotional persistence.)

\ Consequently, this mood has a maximum potential lifetime of 11 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

/ The Patient's disposition of APPROVAL
| toward Doctor has been
\ enhanced by a complementary episode.
/ The Patient's medium-high APPROVAL
\ toward Doctor surfaced.

***** DOCTOR'S EMOTIONS to: Patient> AgreeToTakeMedication (chemo_therapy)

----- Episodes ----->

Medium-high DESPAIR associated with
the Doctor's desire to CureAilmentWithMedicine.
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high DESPAIR associated with
the Doctor's desire to CureAilmentWithMedicine.
Medium-high PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

Medium-low DESIRE associated with
the Doctor's desire to CureAilmentWithMedicine.
...no agent emotion...
Medium-high DISLIKING for chemo_therapy

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering DESPAIR of the Doctor...

/ The Doctor has focused on
\ (Patient AgreeToTakeMedication (medication chemo_therapy)) as an event.
/ The Doctor is now looking forward to the
| event (Doctor ExpressMedicationEffect (effect beneficial)).
| If this event occurs, it will achieve the Doctor's
\ goal of 'CureAilmentWithMedicine' to a medium-high degree.
/ The Doctor believes CureAilmentWithMedicine
\ is desirable to a medium degree.
/ The Doctor thinks the likelihood of the future
| event (Doctor ExpressMedicationEffect (effect beneficial)) occurring
\ is zero.
Doctor feeling medium-high DESPAIR appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- / The old DREAD mood had a potential of 40 life points left.
- | The DESPAIR episode had a potential of 40 life points.
- \ Consequently, the episode was more pervasive.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 8 time units.

For the AGENT_MOOD:

- < There was no episode to effect the current mood of PRIDE.
- < This mood has 50 life points left.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 10 time units.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning EVENTS:

- / The Doctor's medium-low DESIRE
- \ toward (Doctor CureAilmentWithMedicine) surfaced.

Concerning OBJECTS:

- < There is no object episode to effect a disposition.
- / The Doctor's medium-high DISLIKING
- \ toward chemo_therapy surfaced.

**** PATIENT'S EMOTIONS to: Patient> AgreeToTakeMedication (chemo_therapy)

----- Episodes ----->

Medium HOPE associated with
the Patient's desire to CuredByMedicine.
...no agent emotion...
...no object emotion...

----- Mood ----->

High DREAD associated with
the Patient's desire to SecurePersonalHealth.
Medium-high APPROVAL towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
...no agent emotion...
...no object emotion...

::::: EPISODE ANALYSIS :::::::::::::::>

Considering HOPE of the Patient...

/ The Patient has focused on
\ (Patient AgreeToTakeMedication (medication chemo_therapy)) as an event.
/ The Patient is now looking forward to the
| event (Doctor ExpressMedicationEffect (effect beneficial)).
| If this event occurs, it will achieve the Patient's
\ goal of 'CuredByMedicine' to a medium-high degree.
/ The Patient believes CuredByMedicine
\ is desirable to a medium-high degree.
/ The Patient thinks the likelihood of the future
| event (Doctor ExpressMedicationEffect (effect beneficial)) occurring
\ is medium-low.
/ The Patient's contradictory mood caused this episode's
\ degree to be reduced from medium-high to medium.
Patient feeling medium HOPE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old DREAD mood had a potential of 40 life points left.
| The HOPE episode had a potential of 30 life points.
\ Consequently, the old mood was more pervasive.
/ The old mood and episode were contradictory.
\ This caused the new mood's life points to be reduced to 10.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 2 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of APPROVAL.
< This mood has 50 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 10 time units.

**** DOCTOR'S EMOTIONS to: Patient> TakeMedication (chemo_therapy)

----- Episodes ----->

Medium-high DESPAIR associated with
the Doctor's desire to CureAilmentWithMedicine.
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high DESPAIR associated with
the Doctor's desire to CureAilmentWithMedicine.
Medium-high PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->
Medium-low DESIRE associated with
the Doctor's desire to CureAilmentWithMedicine.
...no agent emotion...
Medium-high DISLIKING for chemo_therapy

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering DESPAIR of the Doctor...
/ The Doctor has focused on
\ (Patient TakeMedication (medication chemo_therapy)) as an event.
/ The Doctor is now looking forward to the
| event (Doctor ExpressMedicationEffect (effect beneficial)).
| If this event occurs, it will achieve the Doctor's
\ goal of 'CureAilmentWithMedicine' to a medium-high degree.
/ The Doctor believes CureAilmentWithMedicine
\ is desirable to a medium degree.
/ When (Patient AgreeToTakeMedication (medication chemo_therapy))
| occurred in the past, it reduced the likelihood
\ of (Doctor ExpressMedicationEffect (effect beneficial)) occurring.
/ The Doctor thinks the likelihood of the future
| event (Doctor ExpressMedicationEffect (effect beneficial)) occurring
\ is zero.
Doctor feeling medium-high DESPAIR appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:
/ The old DESPAIR mood had a potential of 35 life points left.
| The DESPAIR episode had a potential of 40 life points.
\ Consequently, the episode was more pervasive.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 8 time units.

For the AGENT_MOOD:
< There was no episode to effect the current mood of PRIDE.
< This mood has 45 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 9 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning EVENTS:
/ The Doctor's medium-low DESIRE

\ toward (Doctor CureAilmentWithMedicine) surfaced.

Concerning OBJECTS:

< There is no object episode to effect a disposition.

/ The Doctor's medium-high DISLIKING

\ toward chemo_therapy surfaced.

***** PATIENT'S EMOTIONS to: Patient> TakeMedication (chemo_therapy)

----- Episodes ----->

Medium HOPE associated with
the Patient's desire to CuredByMedicine.

...no agent emotion...

...no object emotion...

----- Mood ----->

Medium HOPE associated with
the Patient's desire to CuredByMedicine.
Medium-high APPROVAL towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...

...no agent emotion...

...no object emotion...

:::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering HOPE of the Patient...

/ The Patient has focused on

\ (Patient TakeMedication (medication chemo_therapy)) as an event.

/ The Patient is now looking forward to the

| event (Doctor ExpressMedicationEffect (effect beneficial)).

| If this event occurs, it will achieve the Patient's

\ goal of 'CuredByMedicine' to a medium-high degree.

/ The Patient believes CuredByMedicine

\ is desirable to a medium-high degree.

/ When (Patient AgreeToTakeMedication (medication chemo_therapy))

| occurred in the past, it reduced the likelihood

\ of (Doctor ExpressMedicationEffect (effect beneficial)) occurring.

/ The Patient thinks the likelihood of the future

| event (Doctor ExpressMedicationEffect (effect beneficial)) occurring

\ is medium-low.

/ The Patient's contradictory mood caused this episode's

\ degree to be reduced from medium-high to medium.

Patient feeling medium HOPE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- / The old DREAD mood had a potential of 5 life points left.
- | The HOPE episode had a potential of 30 life points.
- \ Consequently, the episode was more pervasive.
- / The old mood and episode were contradictory.
- \ This caused the new mood's life points to be reduced to 25.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 5 time units.

For the AGENT_MOOD:

- < There was no episode to effect the current mood of APPROVAL.
- < This mood has 45 life points left.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 9 time units.

**** DOCTOR'S EMOTIONS to: Patient> FinishMedication (chemo_therapy)

----- Episodes ----->

- ...no event emotion...
- ...no agent emotion...
- ...no object emotion...

----- Mood ----->

- Medium-high DESPAIR associated with the Doctor's desire to CureAilmentWithMedicine.
- Medium-high PRIDE towards Doctor
- ...no object emotion...

----- Dispositions in Focus ----->

- ...no event emotion...
- ...no agent emotion...
- Medium-high DISLIKING for chemo_therapy

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- < There was no episode to effect the current mood of DESPAIR.
- < This mood has 35 life points left.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 7 time units.

For the AGENT_MOOD:

- < There was no episode to effect the current mood of PRIDE.

< This mood has 40 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 8 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::>

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Doctor's medium-high DISLIKING
\ toward chemo_therapy surfaced.

**** PATIENT'S EMOTIONS to: Patient> FinishMedication (chemo_therapy)

----- Episodes ----->

...no event emotion...
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium HOPE associated with
the Patient's desire to CuredByMedicine.
Medium-high APPROVAL towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
...no agent emotion...
...no object emotion...

::::: MOOD ANALYSIS ::::::::::::::>

For the EVENT_MOOD:

< There was no episode to effect the current mood of HOPE.
< This mood has 20 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 4 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of APPROVAL.
< This mood has 40 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 8 time units.

******* DOCTOR'S EMOTIONS to: Doctor> ExpressMedicationEffect (beneficial)**

----- Episodes ----->

High RELIEF associated with
the Doctor's desire to CureAilmentWithMedicine.
...no agent emotion...
...no object emotion...

----- Mood ----->

High RELIEF associated with
the Doctor's desire to CureAilmentWithMedicine.
Medium-high PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

Medium-low DESIRE associated with
the Doctor's desire to CureAilmentWithMedicine.
High PRIDE towards Doctor
...no object emotion...

:::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering RELIEF of the Doctor...
/ The Doctor has focused on
\ (Doctor ExpressMedicationEffect (effect beneficial)) as an event.
/ The Doctor feels the goal 'CureAilmentWithMedicine'
\ has been achieved to a medium-high degree.
/ The Doctor did not feel FEAR toward
\ the goal attending this event in the past.
/ The Doctor did not feel DREAD toward
\ the goal attending this event in the past.
/ The Doctor previously felt medium-high DESPAIR focused on
\ the goal attending this event.
/ The Doctor believes CureAilmentWithMedicine
\ is desirable to a medium degree.
/ When (Patient AgreeToTakeMedication (medication chemo_therapy))
| occurred in the past, it did not indicate effort toward
\ preventing (Doctor ExpressMedicationEffect (effect beneficial)).
/ When (Patient TakeMedication (medication chemo_therapy))
| occurred in the past, it did not indicate effort toward
\ preventing (Doctor ExpressMedicationEffect (effect beneficial)).
/ The system is not aware of Doctor
\ expending effort to prevent this event.
Doctor feeling high RELIEF appears to be evident.

:::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old DESPAIR mood had a potential of 30 life points left.
| The RELIEF episode had a potential of 50 life points.
\ Consequently, the episode was more pervasive.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 10 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of PRIDE.
< This mood has 35 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 7 time units.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning AGENTS:

< There is no agent episode to effect a disposition.
/ The Doctor's high PRIDE
\ toward Doctor surfaced.

***** PATIENT'S EMOTIONS to: Doctor> ExpressMedicationEffect (beneficial)

----- Episodes ----->

Medium-high SATISFACTION associated with
the Patient's desire to CuredByMedicine.
...no agent emotion...
...no object emotion...

----- Mood ----->

Medium-high SATISFACTION associated with
the Patient's desire to CuredByMedicine.
Medium-high APPROVAL towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
Medium-high APPROVAL towards Doctor
...no object emotion...

::::: EPISODE ANALYSIS :::::::::::::::>

Considering SATISFACTION of the Patient...

/ The Patient has focused on
\ (Doctor ExpressMedicationEffect (effect beneficial)) as an event.
/ The Patient feels the goal 'CuredByMedicine'
\ has been achieved to a medium-high degree.

/ The Patient did not feel DESIRE toward
 \ the goal attending this event in the past.
 / The Patient previously felt medium HOPE focused on
 \ the goal attending this event.
 / The Patient believes CuredByMedicine
 \ is desirable to a medium-high degree.
 / When (Patient AgreeToTakeMedication (medication chemo_therapy))
 | occurred in the past, it showed effort toward
 \ realizing (Doctor ExpressMedicationEffect (effect beneficial)).
 / When (Patient TakeMedication (medication chemo_therapy))
 | occurred in the past, it showed effort toward
 \ realizing (Doctor ExpressMedicationEffect (effect beneficial)).
 / The Patient has expended a medium-high degree of effort to realize
 \ the prospect implied by (Doctor ExpressMedicationEffect (effect beneficial)).
 Patient feeling medium-high SATISFACTION appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

/ The old HOPE mood was directed toward the current event as
 | a prospect. Consequently the prospect based SATISFACTION episode
 \ replaced the old mood.
 < This new mood has 40 life points.
 / Each time unit, the mood's life points are reduced by 5.
 | (This is implied by the Patient's MEDIUM emotional persistence.)
 \ Consequently, this mood has a maximum potential lifetime of 8 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of APPROVAL.
 < This mood has 35 life points left.
 / Each time unit, the mood's life points are reduced by 5.
 | (This is implied by the Patient's MEDIUM emotional persistence.)
 \ Consequently, this mood has a maximum potential lifetime of 7 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

< There is no agent episode to effect a disposition.
 / The Patient's medium-high APPROVAL
 \ toward Doctor surfaced.

**** DOCTOR'S EMOTIONS to: Doctor> DeclarePatientFreeOfIllness

----- Episodes ----->

High RELIEF associated with
 the Doctor's desire to FindThatThePatientHasNoAilments.
 ...no agent emotion...

...no object emotion...

----- Mood ----->

High RELIEF associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
Medium-high PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
High PRIDE towards Doctor
...no object emotion...

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering RELIEF of the Doctor...
/ The Doctor has focused on
\ (Doctor DeclarePatientFreeOfIllness ()) as an event.
/ The Doctor feels the goal 'FindThatThePatientHasNoAilments'
\ has been achieved to a high degree.
/ The Doctor did not feel FEAR toward
\ the goal attending this event in the past.
/ The Doctor previously felt medium DREAD focused on
\ the goal attending this event.
/ The Doctor believes FindThatThePatientHasNoAilments
\ is desirable to a medium degree.
/ The system is not aware of Doctor
\ expending effort to prevent this event.
/ The Doctor's complementary mood caused this episode's
\ degree to be increased from medium-high to high.
Doctor feeling high RELIEF appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:
/ The old RELIEF mood had a potential of 45 life points left.
| The RELIEF episode had a potential of 50 life points.
\ Consequently, the episode was more pervasive.
/ The old mood and episode were complementary.
\ This caused the new mood's life points to be increased to 60.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 12 time units.

For the AGENT_MOOD:
< There was no episode to effect the current mood of PRIDE.
< This mood has 30 life points left.

/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 6 time units.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning AGENTS:

< There is no agent episode to effect a disposition.
/ The Doctor's high PRIDE
\ toward Doctor surfaced.

***** PATIENT'S EMOTIONS to: Doctor> DeclarePatientFreeOfIllness

----- Episodes ----->

High RELIEF associated with
the Patient's desire to DetectNoAilments.
...no agent emotion...
...no object emotion...

----- Mood ----->

High RELIEF associated with
the Patient's desire to DetectNoAilments.
Medium-high APPROVAL towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
Medium-high APPROVAL towards Doctor
Medium LIKING for Doctor

::::: EPISODE ANALYSIS :::::::::::::::>

Considering RELIEF of the Patient...

/ The Patient has focused on
\ (Doctor DeclarePatientFreeOfIllness ()) as an event.
/ The Patient feels the goal 'DetectNoAilments'
\ has been achieved to a high degree.
/ The Patient did not feel FEAR toward
\ the goal attending this event in the past.
/ The Patient previously felt medium-high DREAD focused on
\ the goal attending this event.
/ The Patient believes DetectNoAilments
\ is desirable to a medium-high degree.
/ The system is not aware of Patient
\ expending effort to prevent this event.
Patient feeling high RELIEF appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- / The old SATISFACTION mood had a potential of 35 life points left.
- | The RELIEF episode had a potential of 50 life points.
- \ Consequently, the episode was more pervasive.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 10 time units.

For the AGENT_MOOD:

- < There was no episode to effect the current mood of APPROVAL.
- < This mood has 30 life points left.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 6 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

- < There is no agent episode to effect a disposition.
- / The Patient's medium-high APPROVAL
- \ toward Doctor surfaced.

Concerning OBJECTS:

- < There is no object episode to effect a disposition.
- / The Patient's medium LIKING
- \ toward Doctor surfaced.

***** DOCTOR'S EMOTIONS to: Patient> ThankDoctor (great)

----- Episodes ----->

High JOY associated with
the Doctor's desire to SatisfyTheCurrentPatient.
Medium-high PRIDE towards Doctor
...no object emotion...
This implies a compound emotion of high SELF_SATISFACTION.

----- Mood ----->

High RELIEF associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
Medium-high PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->

...no event emotion...
High PRIDE towards Doctor

Medium LIKING for Patient

There is a disposition/episode compound emotion of high SELF_SATISFACTION.

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering JOY of the Doctor...

- / The Doctor has focused on
 - \ (Patient ThankDoctor (severity great)) as an event.
 - / The Doctor feels the goal 'SatisfyTheCurrentPatient'
 - \ has been achieved to a high degree.
 - / The Doctor believes SatisfyTheCurrentPatient
 - \ is desirable to a medium-high degree.
- Doctor feeling high JOY appears to be evident.

Considering PRIDE of the Doctor..

- < The Doctor has focused on the Doctor as an agent.
 - < The Doctor feels high identification towards the Doctor.
 - < The Doctor holds the Doctor at high responsibility for this act.
 - < The Doctor believes this act to be a medium-low praiseworthy act.
 - / The Doctor's complementary mood caused this episode's
 - \ degree to be increased from medium to medium-high.
- Doctor feeling medium-high PRIDE appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- / The old RELIEF mood had a potential of 55 life points left.
- | The JOY episode had a potential of 50 life points.
- \ Consequently, the old mood was more pervasive.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 11 time units.

For the AGENT_MOOD:

- / The old PRIDE mood had a potential of 25 life points left.
- | The PRIDE episode had a potential of 40 life points.
- \ Consequently, the episode was more pervasive.
- / The old mood and episode were complementary.
- \ This caused the new mood's life points to be increased to 50.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Doctor's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 10 time units.

::::: DISPOSITION ANALYSIS ::::::::::::::::::::>

Concerning AGENTS:

/ The Doctor's disposition of PRIDE
| toward Doctor has been
\ enhanced by a complementary episode.
/ The Doctor's high PRIDE
\ toward Doctor surfaced.

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Doctor's medium LIKING
\ toward Patient surfaced.

***** PATIENT'S EMOTIONS to: Patient> ThankDoctor (great)

----- Episodes ----->

Medium-high JOY associated with
the Patient's desire to GetCompetentDoctor.
Medium-high APPROVAL towards Doctor
Medium-high LIKING for Doctor
This implies a compound emotion of medium-high GRATITUDE.

----- Mood ----->

High RELIEF associated with
the Patient's desire to DetectNoAilments.
Medium-high APPROVAL towards Doctor
Medium-high LIKING for Doctor

----- Dispositions in Focus ----->

...no event emotion...
High APPROVAL towards Doctor
Medium-high LIKING for Doctor
There is a disposition/episode compound emotion of high GRATITUDE.

::::: EPISODE ANALYSIS ::::::::::::::::::::>

Considering JOY of the Patient...

/ The Patient has focused on
\ (Patient ThankDoctor (severity great)) as an event.
/ The Patient feels the goal 'GetCompetentDoctor'
\ has been achieved to a high degree.
/ The Patient believes GetCompetentDoctor
\ is desirable to a medium-low degree.
Patient feeling medium-high JOY appears to be evident.

Considering APPROVAL of the Patient...

< The Patient has focused on the Doctor as an agent.
< The Patient holds the Doctor at high responsibility for this act.
< The Patient believes this act to be a medium-low praiseworthy act.
/ The Patient's complementary mood caused this episode's

\ degree to be increased from medium to medium-high.
Patient feeling medium-high APPROVAL appears to be evident.

Considering LIKING of the Patient...

- < The Patient has focused on the Doctor as an object.
- < The Patient is familiar with the Doctor to a medium degree.

Considering PRIDE of the Patient...

- < The Patient has focused on the Doctor as an agent.
 - < The Patient does not identify with the agent.
- Patient feeling PRIDE appears NOT to be evident.

Considering APPROVAL of the Patient...

- < The Patient has focused on the Doctor as an agent.
 - < The Patient holds the Doctor at high responsibility for this act.
 - < The Patient believes this act to be a medium-low praiseworthy act.
 - / The Patient's complementary mood caused this episode's
 - \ degree to be increased from medium to medium-high.
- Patient feeling medium-high APPROVAL appears to be evident.

- / The Patient finds the Doctor NEWLY appealing
 - \ to a medium-high degree.
- Patient feeling medium-high LIKING appears to be evident.

::::: MOOD ANALYSIS ::::::::::::::::::::>

For the EVENT_MOOD:

- / The old RELIEF mood had a potential of 45 life points left.
- | The JOY episode had a potential of 40 life points.
- \ Consequently, the old mood was more pervasive.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 9 time units.

For the AGENT_MOOD:

- / The old APPROVAL mood had a potential of 25 life points left.
- | The APPROVAL episode had a potential of 40 life points.
- \ Consequently, the episode was more pervasive.
- / The old mood and episode were complementary.
- \ This caused the new mood's life points to be increased to 50.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 10 time units.

For the OBJECT_MOOD:

- < There was no previous mood so the LIKING episode became the mood.
- < This mood has 40 potential life points.
- / Each time unit, the mood's life points are reduced by 5.
- | (This is implied by the Patient's MEDIUM emotional persistence.)
- \ Consequently, this mood has a maximum potential lifetime of 8 time units.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning AGENTS:
/ The Patient's disposition of APPROVAL
| toward Doctor has been
\ enhanced by a complementary episode.
/ The Patient's high APPROVAL
\ toward Doctor surfaced.

Concerning OBJECTS:
/ The Patient's disposition of LIKING
| toward Doctor has been
\ enhanced by a complementary episode.
/ The Patient's medium-high LIKING
\ toward Doctor surfaced.

**** DOCTOR'S EMOTIONS to: Patient> TakeLeaveOfDoctor

----- Episodes ----->
...no event emotion...
...no agent emotion...
...no object emotion...

----- Mood ----->
High RELIEF associated with
the Doctor's desire to FindThatThePatientHasNoAilments.
Medium-high PRIDE towards Doctor
...no object emotion...

----- Dispositions in Focus ----->
...no event emotion...
...no agent emotion...
Medium LIKING for Patient

::::: MOOD ANALYSIS :::::::::::::::>

For the EVENT_MOOD:
< There was no episode to effect the current mood of RELIEF.
< This mood has 50 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 10 time units.

For the AGENT_MOOD:
< There was no episode to effect the current mood of PRIDE.
< This mood has 45 life points left.

/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Doctor's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 9 time units.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Doctor's medium LIKING
\ toward Patient surfaced.

**** PATIENT'S EMOTIONS to: Patient> TakeLeaveOfDoctor

----- Episodes ----->

...no event emotion...
...no agent emotion...
...no object emotion...

----- Mood ----->

High RELIEF associated with
the Patient's desire to DetectNoAilments.
Medium-high APPROVAL towards Doctor
Medium-high LIKING for Doctor

----- Dispositions in Focus ----->

...no event emotion...
...no agent emotion...
Medium-high LIKING for Doctor

::::: MOOD ANALYSIS :::::::::::::::>

For the EVENT_MOOD:

< There was no episode to effect the current mood of RELIEF.
< This mood has 40 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 8 time units.

For the AGENT_MOOD:

< There was no episode to effect the current mood of APPROVAL.
< This mood has 45 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 9 time units.

For the OBJECT_MOOD:

< There was no episode to effect the current mood of LIKING.

< This mood has 35 life points left.
/ Each time unit, the mood's life points are reduced by 5.
| (This is implied by the Patient's MEDIUM emotional persistence.)
\ Consequently, this mood has a maximum potential lifetime of 7 time units.

::::: DISPOSITION ANALYSIS :::::::::::::::>

Concerning OBJECTS:

< There is no object episode to effect a disposition.
/ The Patient's medium-high LIKING
\ toward Doctor surfaced.

Appendix C. Quick Overview of Emotions and Constraints

Event Emotions:

JOY	- happy about an event that satisfied a personal goal
DISTRESS	- unhappy about an event that inhibited a personal goal
DESIRE	- looking towards a future event that would satisfy a personal goal
HOPE	- desire towards a future event with some likelihood of the event occurring
ASPIRATION	- desire towards a future event that would imply an elevation of status
DESPAIR	- desire towards a future event with no likelihood of the event occurring
FEAR	- looking towards a future event that would inhibit a personal goal
DREAD	- fear towards a future event that is highly likely to occur
SATISFACTION	- happy about the confirmation of hoped-for event
FEARS-CONFIRMED	- unhappy about the confirmation of a feared event
RELIEF	- happy about the disconfirmation of a feared event
DISAPPOINTMENT	- unhappy about the disconfirmation of a hoped-for event
HAPPY-FOR	- happy about an event that satisfied someone else's goal
SORRY-FOR	- unhappy about an event that inhibited someone else's goal
RESENTMENT	- unhappy about an event that satisfied someone else's goal
GLOATING	- happy about an event that inhibited someone else's goal
SPITE	- looking towards a future event that would inhibit someone else's goal

Event Constraints:

(EventTo *self *act *event)
(EventAchievedGoal *self *event *goal *degree_of_achievement)
(EventInhibitedGoal *self *event *goal *degree_of_inhibition)
(DesirablenessOfGoal *self *goal *degree_of_desirableness)
(PossibleFutureGoalAchievement *self
*current_event
*future_event
*goal
*degree_of_achievement)

(PossibleFutureGoalInhibition *self
 *current_event
 *future_event
 *goal
 *degree_of_inhibition)
 (GoalLinkToPreviousEmotion *self *emotion *goal *degree)
 (LikelihoodOfFutureEventOccuring *self
 *current_event
 *future_event
 *likelihood)
 (EffortToRealizeProspect *self *event *degree)
 (EffortToPreventProspect *self *event *degree)
 (FeelsDeservingOf *self *other *event *degree)
 (FeelsUndeservingOf *self *other *event *degree)
 (ProspectImpliesElevationOf *self *event *degree)

Agent Emotions:

PRIDE - pleased about the praiseworthy action of oneself or someone identified
 with
 SHAME - displeased about the blameworthy action of oneself or someone identified
 with
 REPROACH - displeased about the blameworthy action of someone else
 APPROVAL - pleased about the praiseworthy action of someone else

Agent Constraints:

(AgentTo *self *act *agent)
 (ThinksResponsibleFor *self *agent *act *degree)
 (PraiseworthinessTo *self *act *degree)
 (BlameworthinessTo *self *act *degree)
 (IdentifiesWith *self *agent *degree)

Object Emotions:

LIKING - positive appraisal of an appealing object
 DISLIKING - negative appraisal of an unappealing object

Object Constraints:

(ObjectTo *self *act *object)
(AppealingTo *self *object *degree)
(UnappealingTo *self *object *degree)
(FamiliarWith *self *object *degree)

Compound Emotions:

GRATITUDE	=	APPROVAL	+	JOY
ANGER	=	REPROACH	+	DISTRESS
SELF_SATISFACTION	=	PRIDE	+	JOY
REMORSE	=	SHAME	+	DISTRESS
COVETING	=	SHAME	+	DESIRE

Vita

Rob Warner was born in Long Beach, California on July 31, 1965. Growing up by the ocean, he learned to swim at age 3 and sail at age 8. Upon receiving his first computer, an Apple II+, at age 16, he became fascinated by the art of programming. His first program computed the distances of swimming various routes in the bay outside his home. At age 18, he left home to study at the University of Southern California, where he developed a particular interest in the field of Artificial Intelligence. He received a baccalaureate degree in Computer Science from the university in August of 1987.

Having lived in California all his life, Rob decided to explore a new environment. This desire eventually drew him across the country to the pleasant rural town of Blacksburg, Virginia. There he entered into the master's degree program in Computer Science and Applications at Virginia Polytechnic Institute and State University and received the degree in May of 1991.

While attending the Virginia Tech, he worked as a graduate research assistant for the Management Systems Laboratories of Virginia Tech. He also served as a Justice for the Graduate Honor System.

Rob plans to return to his family and friends in California and to seek employment there. He is not married, but feels hope towards the achievement of that goal in his personal goal hierarchy.

A handwritten signature in black ink, appearing to read "Rob", written in a cursive style.