The Profile Model: A Review and Model of Agent Emotional Architecture and Decision Making

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Abstract

This paper consists of a literature review of various models for emotional architecture and decision making. It follows with a new model, the Profile Model, based on current research. It will then present how the various components within the model interact to make a decision. The potential for further work stemming from this model will be discussed, as well as the importance of defining and modeling emotion.

1. Introduction

When discussing emotion, there is an inherent understanding of what it is. We define other terms using emotion as a basis, such as creativity or understanding; we define a painting as beautiful, or music as pleasing, based on the emotions the art evokes within us. Everyone experiences emotion, yet, currently there is no consensus on a definition for emotion [5]. This is rather compelling, since emotions drive many of our day-to-day, or even life-altering, decisions.

An argument can be made that emotions are rather useless; emotion simply disrupts normal cognitive processing and only impedes the decision making process. However, would evolution have kept emotion in humans if it served no purpose? Is emotion simply some vestigial trait, something evolution has kept as a remnant to serve a previously useful function, but is no longer needed? Or, can it perhaps aid in the decision-making process, and serve as a very useful human trait?

Modeling emotions in agent architecture can have a large impact on a society that is becoming increasingly technology driven. This research is particularly useful in Human-Computer Interaction (HCI) with technology such as intelligent tutoring systems, lie detectors, and software support systems. This paper will delve into current research of emotional architecture and emotional decision making. It will start by visiting a biological approach on emotion, then transition into various models of emotion architecture and how emotion can be used in decision making and social situations. From there, it will present a new model, the Profile Model, which integrates both emotion and logic into the decision making process.

2. Literature Review

<u>The Theory of Constructed Emotion</u> [2]

What is the brain basis of emotion? Did evolution allow for a brain to evolve for emotion? Can we isolate an area of the brain that deals with happiness? Or an area of the brain that deals with anger?

All brains primarily function to accomplish one core task: to achieve allostasis. Allostasis is the mechanism the brain uses to provide the resources necessary to regulate the body's needs for survival. The brain attempts to weigh certain costs and benefits to achieve allostasis, and it does so by anticipating biological needs and satisfying these needs before they become immediately necessary for survival. For example, if the body is running low on fuel, the brain will attempt to elicit a hunger response well before starvation occurs.

How does the brain achieve allostasis? In order to anticipate needs, the brain creates an internal model of the environment and the organism's place within it. This is a rather energy intensive process. If the brain were to create this model solely using environmental input, the intensity would increase dramatically. Hence, the brain must make some educated guesses, and include the environmental input only necessary for survival. It is believed that these educated guesses are based on emotion.

From a physical perspective, the brain regulates the autonomic nervous system, the immune system, and the endocrine system to send chemical and electrical signals to anticipate needs. The visceromotor regions of the brain connect these regions (along with other systems). It is widely believed that the visceromotor regions of the brain contain the circuitry considered to be "emotion". If this is the case, emotions have a very prominent physical response.

The Theory of Constructed Emotion makes the claim that emotions are categories our brain places events into. Therefore, emotions act as constructions of the world, not reactions to it. The brain categorizes past experiences into emotional concepts. For example, it will categorize spending time with loved ones, passing an exam, and achieving business success with the concept of "happiness"; a loved one passing away and failure are categorized as "sadness". A further hypothesis states that in order to further refine this internal model, the brain will take incoming environmental stimuli, and use past experiences to determine what this new sensory input is most similar to.

The idea that emotions are patterns our brain attempts to categorize can be explained using the concept of degeneracy. Degeneracy is a many-to-one mapping of representation to category. In other words, many dissimilar representations give rise to one single category. From a neurology perspective, different populations of neurons fire in order to make sense of one stimulus. Hence, degeneracy can map signals from various populations of neurons to create an instance of emotion, i.e. fear or happiness. Different events can be categorized as happy, or they can be categorized as sad.

The CogAff Architecture Schema [8]

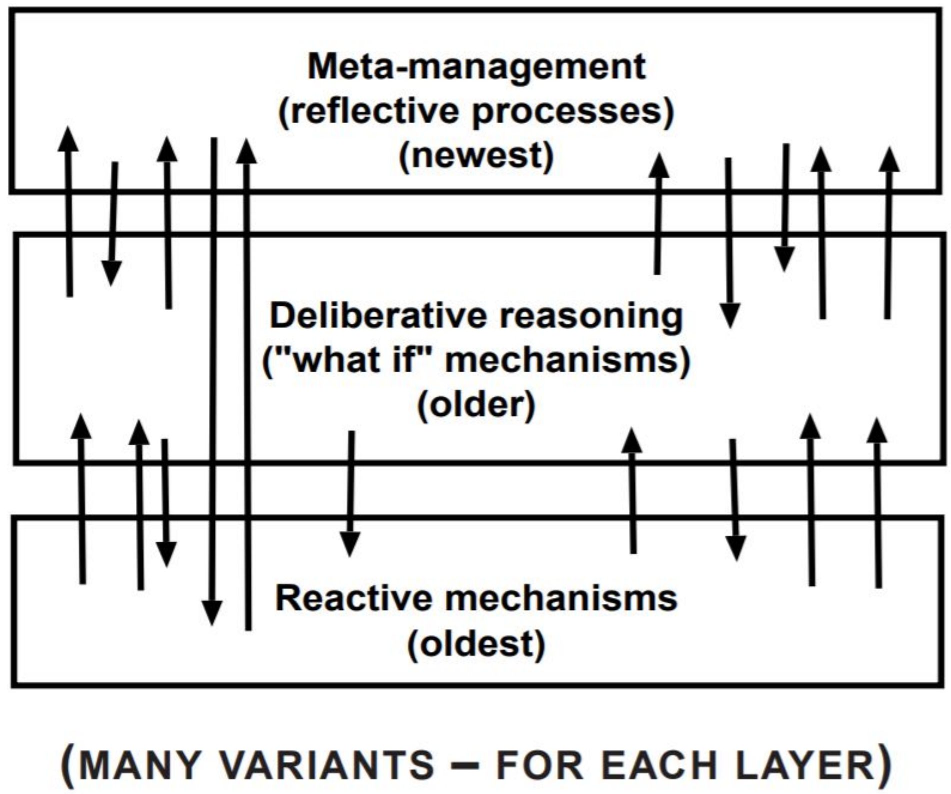

Figure 1

The CogAff architecture schema is a design for emotional layering from The University of Birmingham. The system breaks down emotion handling into three layers. Different types of agents can require some or all of these layers. For example, the cognitive ability of an insect appears to be more simplistic than a bonobo, and may require less emotional processing. This can be further extended to humans, who appear to have the most complex processing ability.

The Reactive Layer is evolutionarily the oldest of the layers, handling primary emotions. Primary emotions are reflex based. When an agent becomes increasingly complex, cognitive processing can become slow; this can be dangerous. For example, if a punch is thrown, an agent cannot take time to process its next action, and must flinch on instinct. The solution to this problem is a fast, powerful global alarm system, designed for quick pattern recognition and speed. This alarm system affects the agent's other subsystems, i.e. endocrine system to send chemical signals (epinephrine, adrenaline) to elicit a fear response. From a physical design perspective, sensors should be linked directly to motors to allow for these quick responses. The downside of this global alarm system is its inaccuracy; because it is optimized for speed, it can send false alarms to other systems. For example, Agent A may simply be raising its arm; however, Agent B may recognize this as a punch being thrown, and flinch as a quick response. This seems to be the only emotional layer present in agents such as insects.

The Deliberative Layer derives from the second stage of evolutionary processing, handling secondary emotions. This layer is focused on potential outcomes, i.e. what if the bridge I'm crossing will collapse, or I fail my job interview? This requires some level of reasoning ability, which is what differentiates it from the Reactive Layer. From a physical design perspective, these are slower and more knowledge-based. The system can receive signals from fast reactive mechanisms that, in some instances, trigger global reactions. The animal agents that have this layer include chimps, bonobos, gorillas, and other mammals.

The Meta-Management Layer is the newest, rarest stage of evolutionary emotion processing, handling tertiary emotions. This layer handles reflective processing. The primary differentiator between tertiary and secondary emotions is tertiary emotions involve disruption in self monitoring and control mechanisms, leading to loss of control in a current thought process. Examples include infatuation with someone, guilt about betraying someone, pride in success, jealousy over someone, longing for a loved one, etc. Feeling betrayal by a loved one can lead to disruption in an agent's daily activities, i.e. when working on a project or going for a run. These seem to be more social in nature. From a physical design perspective, the self-monitoring, self-controlling meta-management systems can be altered by other subprocesses. Mechanisms for monitoring and evaluating must be included in the physical design of the Meta-Management Layer. The greater the sophistication of the agent, the more likely they are to use culturally determined categories, hence experiencing emotion such as guilt or self-torment. The animal agent that has this layer is primarily humans.

It is important to note that these three layers all interact with one another, depending on which layers are present within the organism (see figure 1). An example of this interplay can be seen with an engineer approaching a new problem. The Reactive Layer can signal a fear response to seeing a problem that is brand new. The Deliberative Layer can lead the agent to focus on potential outcomes, i.e. what if I get the problem wrong? The Reactive Layer can disrupt normal daily activity, such as when the agent is washing dishes, it will feel like other agents despise it, and it will be a burden on the team.

An Architecture for Emotional Decision-Making Agents [3]

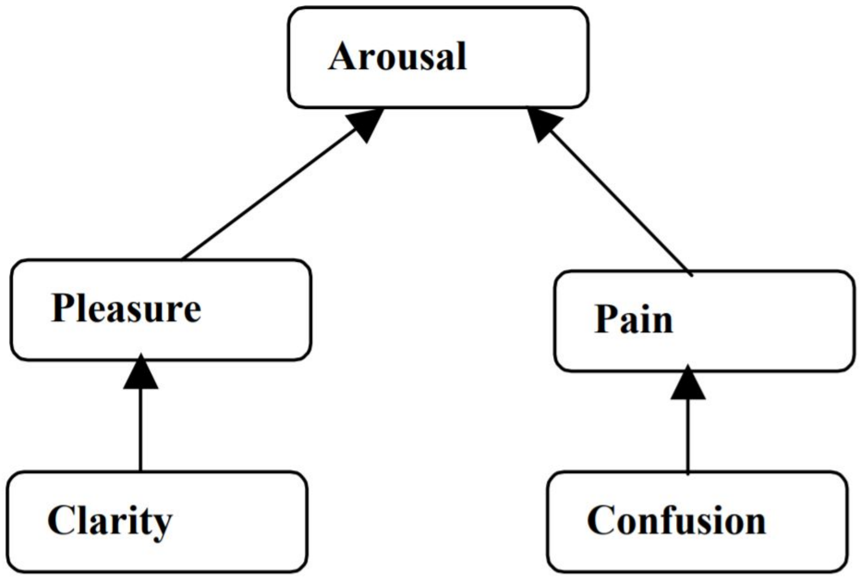

Figure 2

This model for emotional agents involves separating the cognitive processing and emotional processing capabilities. Working memory forms an interface between both mechanisms, consulting both before acting. Emotional processing can be broken down into three key assessments, each dealt with in separate sub-mechanisms.

Clarity and confusion determine the efficiency of the agent's current structure in regards to the current situation. If the current structure of an agent is not optimally designed to tackle the current situation, the agent will become confused. However, if the current architecture is in-tune with the current situation, the agent will feel a sense of clarity. This can be seen with humans attempting a new problem. The first response will be a sense of confusion, as their current knowledge structure does not know how to solve the problem.

Pleasure and pain determine the potential benefit of the current situation, or level of danger. Pleasurable situations are replenishing for the agent, and include allostasis benefits i.e. reproduction. Painful situations, however, can be directly damaging to an agent, or have potential for danger. When an agent experiences pain or pleasure, it can alter their decision-making process. For example, if an agent's hand is close to a flame, its decision will be to solely remove its hand from the flame to avoid the danger of burning.

Arousal determines the importance of the current situation. Arousal triggers chemical/physical reactions, including increased heart rate and respiration, alteration in dopamine, norepinephrine, and other chemical levels. The emotional system as a whole interacts with the cognitive system (in particular, memory and attention components) through arousal.

There is a hierarchical structure of these components, as clarity/confusion lead to pleasure/pain, which lead to arousal (see figure 2). The overall goal of this architecture is to generalize emotion, avoiding the use of specialized processing for each specific emotion. For example, fear comes from anticipation of pain, anxiety is similar to fear but resulting arousal is lower, etc. Some actions trigger solely at specific arousal levels. For example, fight/flight only triggers at very high arousal levels, and sleep only triggers at very low arousal levels. Other actions trigger on a range of arousal levels, interplaying with cognitive processing.

Tok Project [7]

Tok is an AI architecture designed at Carnegie Mellon University. Tok is designed to be used within the virtual world, Oz. It is implemented within artificial beings, known as Woggles, that live in Oz. Tok's design has two main components: HAP and Em.

HAP deals with action. It takes in perception, emotional state, goal information, and other features of the agent's internal state, and determines the best course of action from this information. It does so by choosing sets of actions (plans) from a library, for each specific goal within Oz. Each plan is a collection of subgoals and actions, designed with the larger goal in mind. This is a one-to-many mapping, where one goal can map to many different plans. If one plan fails, a backtracking search is conducted to try the next plan. An Active Plan Tree (APT) is used to prioritize goals and plans. This provides a hierarchical structure, assisting the agent in managing which goals and plans are most important or most beneficial.

Em deals with emotion, supporting around 20 different emotion types. Emotions are invoked by reaction to a goal succeeding or failing, or a sense that a goal can be achieved or failed. Therefore, the emotional types Em supports are goal-based. Em also has a large social aspect as well; one agent's emotions/actions can affect another agent's. For example, if Agent A is in distress, and performs a negative action onto Agent B, B will become distressed because of A's emotional state and action. One key differentiator between Em and other emotional architectures is the ability for an agent to experience emotional decay. Agents' emotions can fade over time, however, attitudes and standards of an agent remain relatively stable. For example, Agent A can feel love towards Agent B when spending a lot of time together. However, if B leaves the environment for an extended period of time, A's love for B can fade. However, A's attitude and perception of B remains stable, and only becomes unstable once B causes distress onto A (such as showing anger to A). Similar to HAP with its APT, emotions are also stored in a tree structure, although without the sense of priority. The branches within the tree become more and more emotionally specific. For example, distress is the parent of many children, such as homesick and lovesick. This design allows for extensibility and a one-to-many mapping, allowing an overall emotional state to map to many specific emotions. Each specific child emotion dictates the actions an agent will take, even though the parent emotion is the same.

Tok's key aspect is its integration of both HAP and Em when making a decision. HAP and Em do not fight with one another to control action selection. Rather, actions are chosen based on an interplay between an agent's emotions, reasoning, and preferences. It's important to note that, because of Tok's design, examining emotions is only useful when they affect other systems, primarily the decision making mechanism. For example, if an agent feels distress towards a past event, if the agent chooses not to act on the distress, the emotion is no longer significant. Emotions can affect other systems as well, such as physiological responses in adrenaline rush/muscle tension during panic, and inferences, social relationships, and learning being altered.

Using Decision Theory to Formalize Emotions for Multi-Agent System Applications [4]

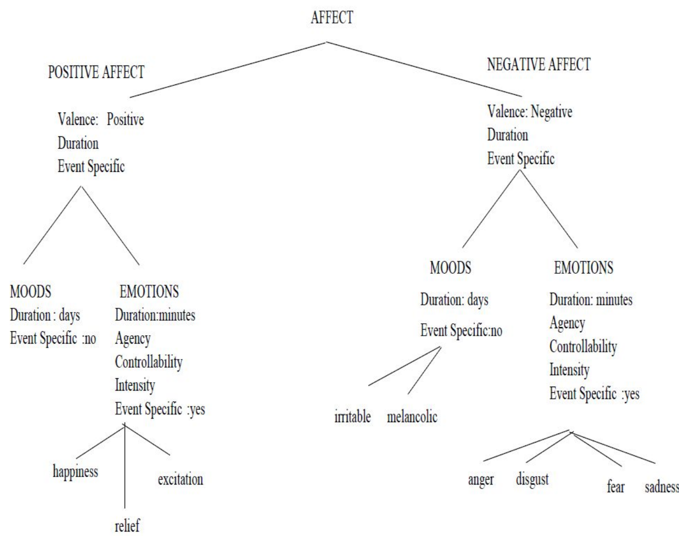

Figure 3

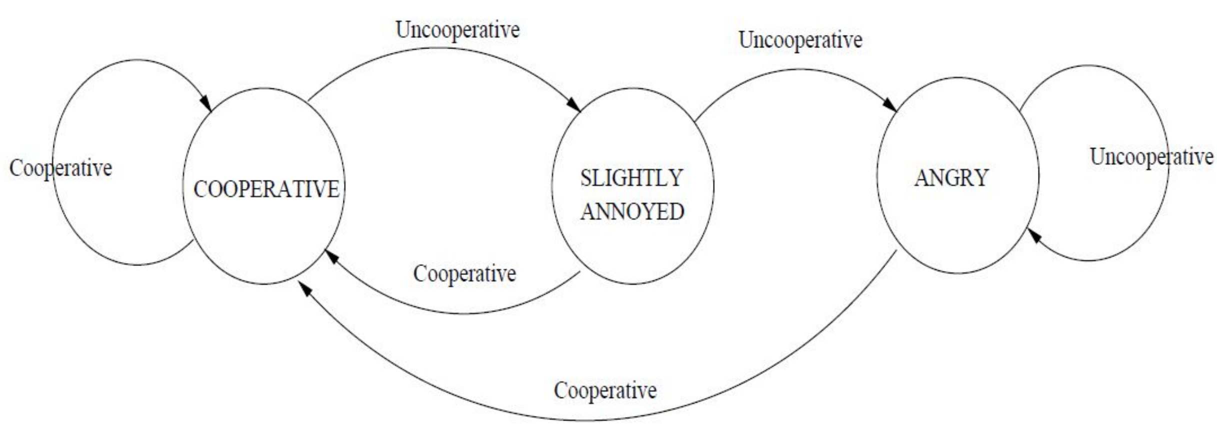

Figure 4

Not only must emotion be modeled as an architecture, but that architecture must be used to make a decision. This is especially critical in multi-agent environments. Using decision theory, the formal definition of a rational agent is an agent who acts to maximize some performance measure by maximizing expected utility. This definition can be used to model both a decision making situation, and computing an agent's decision based on emotional state.

A decision making situation can be formalized as a quadruple $\underline{D=<P_c(S), A, Proj, U>}$. An environment may not be fully observable, hence, a probability distribution, P, may be applied over the set of all possible states, S, resulting in P(S). $\underline{P_c(S)}$ denotes the probability distribution applied to a particular state (note an entropy function can be applied to states as well). A decision making situation also consists of a set of action plans (the action space) the agent can execute. This is a finite set, A, consisting of specific plans, a_i, which are associated with a future time horizon, t_{ai}. Due to non-deterministic behavior of an agent's actions, the resulting state can be one of many. A projection function, Proj, is used to project the results of an action plan, a_i, given the current information about the state, $P_c(S)$, resulting in information about the resulting state or states. Since a rational agent acts to maximize utility, desirability of a resulting state is determined via a utility function, U. U maps a state of the world to a real number. The higher this real number, i.e the utility, the higher the desirability. An agent will seek to find the best a* (sequence of action plans) to maximize this utility. Utility is more useful when assigned to state attributes, rather than the state itself. For example, human agents tend to aim for all states that contain the most wealth or the most health. Preferences and weights are associated with each attribute as well, leading to trade-offs. For example, one agent may prefer health over wealth. Therefore, a decision making situation, D, can be defined as $<P_c(S), A, Proj, U>$, which fully specifies an agent's knowledge of the environment, assessment of possible actions, possible results of these actions, and desirability of the possible results.

Computing the best possible action within a decision making situation is costly, especially within multi-agent environments. Emotional states provide a mechanism to manage the computational resources necessary to make decisions. Emotional states must adhere to some taxonomy in order to be properly defined (see figure 3). In addition, transitions between emotional states must be modeled. An example of transition modeling can be seen with the finite automata in figure 4. The advantage of this dynamic transition model is that a finite automata can be learned by an agent. An agent can transition between multiple emotional states via an emotional transformation equation, EmotTrans(D,IN) = D', where D is the initial emotional state, IN is a (possibly empty) history of environmental inputs, and D' is the agent's new emotional state.

The agent's current emotional state can have a large impact on the decision making process. If an agent is currently in an angry emotional state, it may only consider actions involving aggression, narrowing A to only contain actions promoting aggression. A special case is when A becomes a singleton set, where A only consists of one action (i.e. flee when in danger). U can be transformed as well. For example, those in a positive emotional state (i.e. elated) may associate a higher utility to all possible environmental states, whereas those in a negative emotional state (i.e. depressed) may assign a lower utility to all possible environmental states (weights associated with attributes can also be affected). Being under a time constraint can affect P(S). If an agent is in a panicked emotional state, it may only consider states that are most likely possible, and ignore those that are less likely to occur. This is analogous to only considering the most likely result of an action, and ignoring all less likely results. This can also lead to short-sightedness, narrowing A even further (by associating a smaller time horizon to each action).

BayesACT [1, 6]

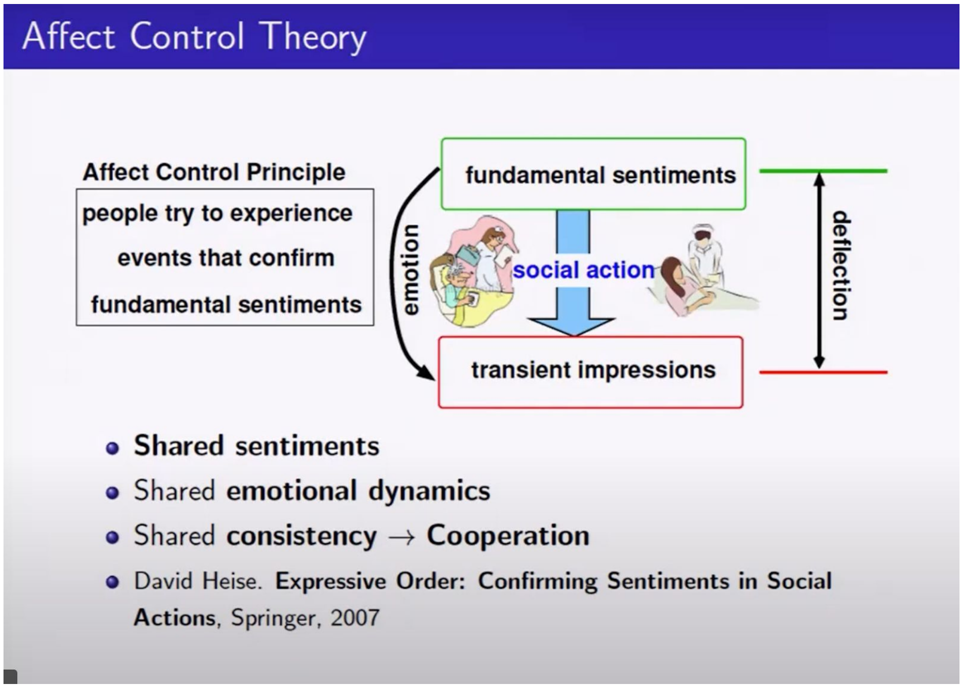

Figure 5

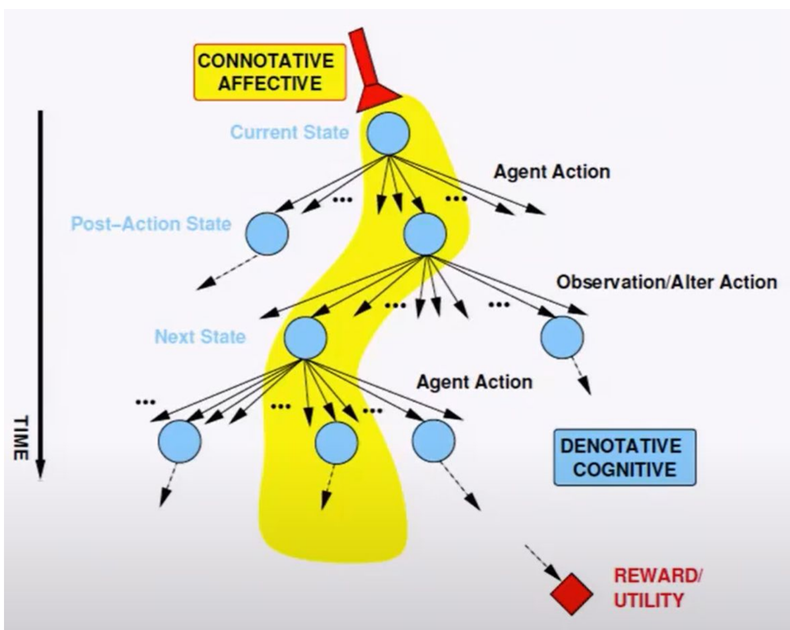

Figure 6

A critical aspect of emotion involves reacting to social situations. Social knowledge comes from being immersed within a culture, and learning how to act in accordance to that culture's values. Affect Control Theory (ACT) states that people carry around fundamental sentiments that are culturally shared. These fundamental sentiments are how one should behave in accordance to others, with respect to a cultural expectation. This can be modeled in a three dimensional space known as the affective space. These three vectors are Evaluation (good/bad), Potency (power), and Activity (active/inactive), collectively known as the EPA profile of a culture. The EPA profiles differ by culture. For example, most English speakers rate professors as nice as students (E), more powerful (P), and less active (A). In Japan, professors are rated such that they have the same P ranking as the English speakers, however, students are seen as less powerful.

ACT argues that people act to minimize the difference between their cultural impressions and what they experience during social interaction (see figure 5). Social events, and the actions that occur during them, create transient impressions on the observer, depicting how an observer feels about a certain action within a social context. Deflection is the level at which fundamental sentiments differ from transient impressions. Hence, ACT argues that people try to minimize deflection in order to achieve emotional consistency, and will therefore act in culturally permissible ways. Emotion can be seen as a result of this deflection.

Emotion is used to signal to another agent on how they can minimize deflection, and achieve emotional consistency. A common example of this theory can be seen with a nurse treating an ailing patient. If the nurse is kind and gentle with the ailing patient, this results in comforting feelings within both the nurse and the patient (low deflection, since this behavior is expected). However, if the nurse becomes negligent by ignoring the patient's pain, or if the patient is particularly rude to the nurse, these situations can become distressing. The patient can feel neglected, and the nurse can feel attacked (high deflection, since this behavior is not expected). This leads to the patient complaining or the nurse attempting to calm the patient down. Both are acts of one agent attempting to communicate with the other on how to behave in a social context in order to minimize deflection.

BayesACT is a model that adds ACT to a multi-agent partially observable Markov decision process. A partially observable Markov decision process contains a set of states, observations of these states, an observation function, a set of actions an agent can take, a transition function (S,A) -> S', and an agent's preferences. An agent can reach a belief state after performing an action (mapped by the transition function). The other agent will act as well, leading to another state. A forward search on a decision tree is used to pick the best action in order to optimize utility. The issue with this tree model is that it is rather large, leading to large time and space complexity ratings. It will take an agent a very long time to process all possible outcomes of all possible actions they can take.

BayesACT minimizes the size of this tree, allowing faster decision making. Random variables for transient impressions and fundamental sentiments, along with an impression formation equation to determine belief of transient impression states, are added to the above model (it is important to note that both transient impressions and fundamental sentiments can change over time, i.e. living in a different culture). By applying ACT, an agent needs only to consider actions that make social sense. An agent will only pick from actions that are socially acceptable, those with a low deflection. This dramatically reduces the size of the decision tree, decreasing the branching factor by a large amount, leading to much faster decision making (see figure 6).

BayesACT has large applications in group decision making. Ideally, an agent will consider actions that will lead to the highest utility for the group. Trust plays a large part in this process. An agent with large trust in the group will choose an action that is more in line with the group's beliefs, regardless of cognitive reasoning. Trust plays a major factor in how well a group can perform, as decision making becomes simplified for everyone in that group.

3. The Profile Model

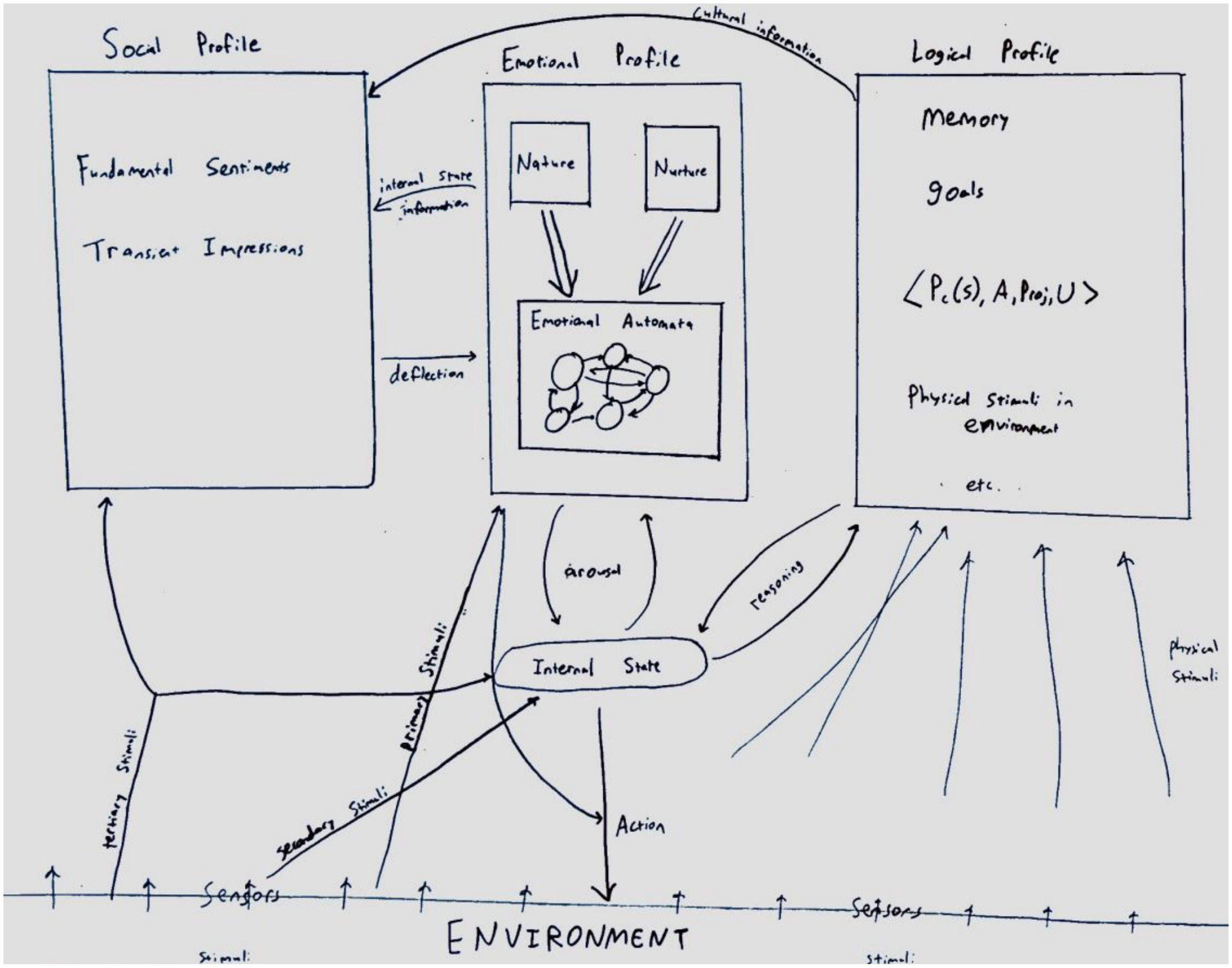

Figure 7

The Profile Model is constructed from ideas presented in all above mentioned research. The overall idea is that emotions and logic work together to update some internal state. This idea of both centers working together to make decisions is similar to the interactions between HAP and Em in the Tok Project [7].

Components

Decisions are made based on the interplay of the Profile Model's profiles. These are the Emotional Profile, the Logical Profile, and the Social Profile. These profiles work together to update the Internal State, which then decides on an action for the agent to take on the environment.

The Emotional Profile contains three different subsystems. The Nature subsystem contains any predispositions the agent has. In human agents, these are genetic predispositions that can have a large effect on emotion, i.e. bipolar disorder, depression, anxiety, etc. The Nurture subsystem contains emotional concepts. It contains certain events that have occurred throughout an agent's lifetime, and categorizes these events into emotions. For example, happiness can be seen as a category consisting of spending time with loved ones, watching a movie, eating chocolate, etc. These events form some sort of pattern, and the Nurture subsystem records these patterns, and what emotional response these patterns can be categorized into. This idea of emotional concepts follows [2]. The Nurture subsystem also contains varying emotional intensities, such as seeing some events as being extremely happy (as compared to moderately happy), and some events being extremely saddening. The Emotional Automata is a finite automata, consisting of emotional states. Each emotion has a single state within the automata. For example, there is a happy state, an angry state, a sad state, etc. One of these states is the current emotional state of the agent. This idea of a finite automata being used to map emotional states is discussed in [4].

All three subsystems play critical roles in determining an agent's current emotional state. The transitions between emotional states in the Emotional Automata are impacted by both the Nature and Nurture subsystems. For example, a human agent containing a reference to bipolar disorder in their Nature subsystem can experience drastic transitions from a happy state, to an angry state, to a sad state. Nurture's impact can cause transitions between states to become dulled. For example, an agent who is depressed may only transition between an intensely sad state, to a moderately sad state. In contrast to Nature, Nurture is constantly changing. Hence, the emotional automata is in constant flux, being impacted frequently by the Nurture subsystem, with transitions between emotional states changing in intensity throughout an agent's lifetime. The idea of Nurture's input in emotional states follows the emotional transformation equation presented in [4]. Nurture consistently updates itself with a timeline of events. Recent events cause stronger emotional responses because of Nurture's strong impact on transitions of an agent's Emotional Automata. However, once these events become less recent, they have less of an impact on Nurture, dulling their effects on emotional transitions. For example, in human agents, experiencing loss of a loved one is typically difficult to bear in the beginning, but is easier as time moves on. This concept follows the idea of emotional decay [7].

The Logical Profile hosts strictly factual information, i.e. memory. These include language, physical patterns, physical stimuli from the environment, and specific events throughout the agent's lifetime. It contains goal information, as well as a preference towards goals with highest utility. This idea of categorization of goal information is similar to HAP [7]. Allostasis is the primary goal [2], and has the highest utility.

The Social Profile contains information about the agent's culture, dictating how an agent should act in social situations. Fundamental sentiments are housed here and transient impressions are created here [1, 6]. The proximity of the Social Profile to the other profiles is a key part of this architecture. As seen in the model, the Social Profile is kept very close to the Emotional Profile, and further from the Logical Profile. This allows for quick, sometimes very intense, emotional transformations due to social influences, i.e. a loved one passing away, or a betrayal. Behavior in social situations in general has a very large emotional component to it. The Social Profile is housed further away from the Logical Profile because cultural behavior is learned over time. This can be clearly seen with a baby and his/her mother. A baby does not understand how to behave in public, i.e. screaming and crying in a social situation. However, the baby will immediately cry if his/her mother does not give them attention, out of a sense of betrayal, disregarding all social norms. Once attention is restored, the baby will quickly transition to happiness. The proximity of the Social Profile to the Emotional Profile is very important in human agent architecture, since humans are primarily social animals and rely heavily on social relationships. They will act to maximize social and emotional consistency, following ACT [1, 6].

The Internal State is an internal representation of the world and the agent's place in it. It attempts to create a model of the world with as much factual information provided by the Logical Profile. Since this process is quite energy intensive, it will fill in any gaps using information from the Emotional Profile. This follows the brain's internal model representation [2]. Internal State acts as an interplay between emotion and logic, similar to working memory [3].

Component Interactions

The various components of the Profile Model interact in order to make the best decision possible for the agent, given the environmental and previously stored information. Sensors take in environmental percepts, which are immediately sent to the Logical Profile for processing. This will construct specific facts of the environment and the percept sequence. The Logical Profile then communicates with the Internal State through reasoning. The reasoning is composed of many different pieces, such as patterns recognized and goal information.

Internal State will proceed to interface with the Emotional Profile. The Emotional Profile determines an emotional response to the input from the Internal State. It will first interact with the Social Profile, comparing what is changed in the internal state with fundamental sentiments. Transient impressions are created here, which are then compared with the fundamental sentiments to determine a deflection rating. This deflection is returned to the Emotional Profile.

The Emotional Profile then accesses its three subsystems. The Nurture subsystem is updated with this new experience and deflection, and together with the Nature subsystem, may invoke a change onto the Emotional Automata. This may trigger a change in the current emotional state, which is then communicated to the Internal State through arousal.

So far, the Internal State has been given information from the Logical Profile, sent this to the Emotional Profile (who interfaces with the Social Profile and its own three subsystems), and received processed feedback from it. At this point, the information contains both logical and emotional/social assessment. The Internal State can now assess and determine the best action for the agent to perform, and the agent will perform these through its actuators.

There are a few additional key aspects of the model. Over an agent's lifetime, the Logical Profile updates the Social Profile with cultural information. This information is continuously updated, and may radically change if the agent is placed in a new environment, i.e. when a human agent moves to another area with drastically different cultural norms. Fundamental sentiments are updated, induced by the Logical Profile.

Goals within the Logical Profile contain a certain utility, and the agent will aim to maximize total utility. Allostasis is the highest utility, and the agent will primarily act to achieve allostasis. For example, if an agent needs food, it will update the Internal State to be at a hungry state. If the Internal State remains in a hungry state, it will communicate with the Emotional Profile to transition to an angry emotional state, and will stay here until food is eaten and allostasis is achieved.

The type of stimulus determines interactions within the Profile Model. The three types of stimuli are primary, secondary, and tertiary stimuli [8]. Primary stimuli require quick responses, and do not have time to process information (such as fight/flight responses). Hence, it will interface directly with the Emotional Profile and take action, ignoring all other profiles and Internal State. Secondary stimuli is not as immediate, and will interface directly with the Internal State. Tertiary stimuli is more social-oriented (i.e. missing a loved one), and will have a direct interaction with the Social Profile in addition to the Internal State.

4. Conclusion and Further Work

This paper discussed how an agent can be modeled using emotion as a key aspect of the decision-making process. It first discussed different approaches to emotional architecture and decision-making, and used these sources as references to present a new model.

This model has many points that can be expanded upon. For example, the Logical Profile and Social Profile are not as well defined as the Emotional Profile. Both areas can be improved upon, and an updated Profile Model can be created. Another key area of improvement can be changing the architecture based on the type of agent. The Profile Model was created with human agents in mind, but can be updated for a different type of agent. For example, an insect agent may have very minute Logical and Social Profiles, a canine agent may have a very strong Social Profile (due to their pack-oriented nature), a feline agent may have a very strong Logical Profile, etc. The weights of some profiles can outweigh the other profiles, leading to more specialized agents. All in all, the Profile Model can be a good starting point for further implementation of emotion in agent architecture design and decision making.

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