

A Reflexive, Not Impulsive Agent

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ABSTRACT

The aim of our present research is to build an Agent capable of communicative and expressive behavior. The Agent should be able to express its emotions but also to refrain from expressing them: a reflexive, not an impulsive Agent. A Reflexive Agent is an agent who thinks it over before displaying one's emotions, that is, one who, when feeling an emotion, "decides" not to display it immediately. In this paper we present our enriched discourse generator and we give a general overview of the factors that we consider to determine the displaying or not displaying of an emotion.

1. INTRODUCTION

Up to now, Artificial Agents are not yet endowed with the capacity of feeling emotions, mainly because emotion would imply an involvement of the hardware of a machine; and this might be impossible, or at least difficult, still for some years [6]. But let us suppose we have an Agent that is able to feel emotions; what could it do? How could it behave? Would it express its emotion to a potential interlocutor, or would it ruminate on its own emotion by itself, without showing its feeling? The aim of our research is to build an Agent that is able to express its emotions but also to refrain from expressing them: a reflexive, not an impulsive Agent. In this paper we present a general overview of the factors that affect the displaying of one's emotion or not.

2. EMOTION TRIGGERING FACTORS

Emotions, as we know, are a biological feed-back device whose function is to provide information about the state of achievement or thwarting of our most important adaptive goals. Every time a relevant event happens in the environment (or is simply assumed to happen by a System), due to which an important goal of the System (the goal of survival, bodily safety, reproduction, image or self-image) is, or is likely to be, achieved or thwarted, the feed-back device of Emotion is activated; this consists of a set of somatic, physiological, psychological, expressive and motivational issues that alert the System and, at the same time, provide the necessary energy and resources for reaction. From the

agent's interpretation of the situation, an emotion is triggered. We use emotion types as defined in Elliott's Affective Reasoner, in which 24 emotions are described [3].

3. EMOTION REGULATION FACTORS

Now, the expressive part of the emotional reaction (the fact, for example, that we open eyes wide in fear, or make a frown in anger, or blush in shame) usually has a useful adaptive function. For example, showing my rival I am angry with him may induce him to leave the field. Sometimes, though, expressing our emotion may be dangerous rather than useful. If I show fear in front of a rival, this may give him a weapon and may oblige me to leave the field. Humans, then, learned to be flexible in the use of the expressive part of the Emotion syndrome: that we are biologically endowed with a repertoire of display devices does not necessarily mean that, any time we feel an emotion we immediately, coercively and unthoughtfully, display that emotion.

In fact, a famous elaboration around this topic is Ekman and Friesen's [2] notion of display rules: the rules prescribed by cultures about when, how, to whom express one's emotions. What we are trying to do in our work is to propose a formalization of some of these rules.

We start from the following question: what are the factors that determine if an Agent that is feeling an emotion will display it or not? In our view, this depends on two aspects of the emotion: on the one side, whether and how to display an emotion depends on the very nature of the emotion itself (emotional nature); on the other side, it is determined by the interaction of multiple factors (scenario factors).

1. Emotional nature

- 1.1. Emotion valence: Emotions may be either positive or negative, in that feeling them may be pleasant or unpleasant.
- 1.2. Emotion social evaluation: Emotions may be socially approved or sanctioned. The latest ones are much less prone to be displayed (e.g. envy, shame).
- 1.3. Emotion Addressee: Among social emotions, some may be directed toward the interlocutor or toward a third person. It might be easier for me to say I contempt a third person than I contempt you.

2. Scenario Factors

- 2.1. Agent's Display motive: There might be several reasons one displayed an emotion. One may look for consolation, empathy, advice... We call display motive the reason (that is the specific goal) that induces us to display a particular emotion in a particular situation.

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- 2.2. Agent's personality: An impulsive person will tend to display emotions more often than a shy or ruminative person.
- 2.3. Interlocutor's features: In determining to display an emotion or not, the Agent also takes into account the features s/he attributes to the Interlocutor. The relevant features are, in our view: the Interlocutor's personality and her cognitive capacity (including comprehension, experience and problem solving skills).
- 2.4. Agent - Interlocutor Role relationship: By role relationship we mean the power and intimacy relationship between the Agent and the interlocutor. One might not show his anger to his superior.
- 2.5. Agent - Interlocutor Personal Relationship: The personal affective relationship between interlocutors determines the display or not of an emotion.
- 2.6. Type of social interaction: The last important factor in the regulation of emotions is whether interaction occurs in public or not.

4. THE AGENT BEHAVIOR PLANNER

The reflexive component of our agent's mind is achieved by a planning mechanism able to reason about emotion triggering and regulation. It builds a plan containing, not only verbal communicative goals, but also information relative to emotion display [1]. It is also interfaced with the face generator module.

The first step consists in producing a plan, according to the posted communicative goal. This plan can be built by a planning algorithm, from a *library of plan operators*, or it may be retrieved from a *library of plans* representing a set of recipes for achieving particular domain goals. In both cases, the output is a plan tree (D-Plan) that defines the content and order of information to be conveyed by the discourse. In our case, the planner uses a library of non-instantiated plans, represented in XML according to the DPML specification [1], to select the plan that satisfies the posted goal. If such a plan is not available in the library, the planner builds it by appropriately combining the existing plans. The generic plan is, then, instantiated by filling the variable-slots with domain data. The core module of the system (called 'Hamlet'), that simulates the reflexive component of our Agent's mind, enriches D-Plan with information about emotion display. This is done with two sets of rules: *triggering rules*, that establish whether a particular emotion is 'felt' by the Agent, and *regulation rules*, that are employed to decide whether to display the felt emotion (similar to Ekman & Friesen's *display rules* [2]). If Hamlet decides to display the felt emotion, then the plan step is enriched with this information. Notice that the planner applies an inheritance mechanism in order to propagate the 'Display' label from its parent-node; the 'NotDisplay' label is simply not inserted in the plan. The general structure of a triggering rule is the following:

IF DC-Cond THEN (Feel Ag e),

where: i) DC-Cond represents a condition on the context and/or the domain, ii) Ag denotes the agent that is conveying the signal; iii) e denotes an emotion; iv) Feel is a predicate which applies to the two previous terms, to denote that 'the Agent Ag feels the

emotion e'. For social emotion, it applies to three terms: the Agent, the emotion, and the one to whom the emotion is addressed. Examples of triggering rules are:

IF (Desirable Ag focus(D-Plan goal)) THEN (Feel Ag Joy),

IF (Undesirable Ag focus(D-Plan goal)) THEN (Feel Ag Distress)

Once an emotion has been triggered, the *regulation rules* are activated to decide whether this emotion has to be displayed in the given context. The general structure of the regulation rules is the following (I stands for Interlocutor):

IF (Feel Ag e) AND DC-Cond THEN (Display Ag e), or

IF (Feel Ag e) AND DC-Cond THEN NOT (Display Ag e),

Some examples of *regulation rules* are:

IF (Feel Ag Joy) AND (Envious I) AND (Adoptive Ag I) THEN NOT(Display Ag Joy)

If the Ag is happy, Ag may not display her happiness to a friend (I) who is usually envious.

IF (Feel Ag Fear) AND (Apprehensive I) AND (Adoptive Ag I) THEN NOT(Display Ag Fear)

If Ag is frightened, Ag will not display her fright to an apprehensive friend (I), not to make him worry.

Once the enriched-plan E-Plan has been computed, it is delivered, as an XML document, to the Goal-Media prioritizer module [1]. This module starts from the enriched plan and decides, according to the context, the type of non-verbal signals that gets instantiated (raising eyebrow / head nod / smile), their combination and their synchronization with verbal communication. The output of this module is an XML structure that represents the final presentation plan, where the media have been instantiated and, when necessary, synchronized. Finally, the XML tags are converted into MPEG-4 facial parameters that drive the final animation.

5. CONCLUSION

In this work we have presented the architecture of a reflexive agent. We have defined the different elements on which the "decision" of display or not display is based on (emotional nature and scenario factors). Our enriched discourse generator uses these elements to plan the verbal and nonverbal part of a discourse that satisfies a given communicative goal. For achieving this, two set of rules are considered: the triggering rules that fire an emotion and the regulation rules that make the agent a reflexive agent.

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