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Appraisal for a Character-based Story-World

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Abstract. Generation of interesting narratives in a simulated dramatic story-world requires situated software agents with emotional competences. The operationalisation of concepts from appraisal theories of emotion can provide flexible roleplayers that reduce the required external macro-level control. Situatedness and the analysis of the social lifeworld of characters are the foundations of the presented architecture that is used to generate simple cliché plots. The subjective evaluative interpretation of changes in a character's environment and appropriate reactions provide for the causal and emotional connections that can lead to the unfolding of a story. The architecture is a contribution towards a process-oriented model of emotional phenomena.

1 Introduction

Interactive narrative and storytelling that employ the specific possibilities of new media face the problem of how not to restrict the medium's flexibility while still ensuring interesting plot structures. Story-worlds based on autonomous characters can provide an environment in which users actively participate in the creation of a plot, but this presupposes a level of competence on the part of the characters that ensures they will act appropriately and adapt to changes in their environment so that the resultant structure is plot-like. We believe such competence includes emotionality, motivated by the observation that emotional descriptions are constituents of dramatic plots and by the role of emotion for acting in dynamic environments.

This work describes part of the ActAffAct project (Acting Affectively affecting Acting [35]) that researches a bottom-up approach to imitating emotional characters that interact in a story-world. The goal is to achieve the unfolding of plot-like structures [15, 18] while limiting the use of macro-level control—as exerted by, e.g., a director. The ideal level of macro-level control would be none at all, so that the plot would emerge from the interaction of the characters; i.e. having reusable roleplayer agents [36]. Our approach views emotions as the links

between actions that render a plot plausible, and—setting out from a characterisation of story-worlds (section 2)—this paper focuses on the following aspects:

- The design of the agent architecture for a synthetic actor starts from the premise of its situatedness in the story-world. This leads to an approach to agent behaviour that uses the analysis of its (intended) lifeworlds to structure its capabilities. For the scenario of dramatic interactions, the social lifeworld of the characters [37] plays the central role. (section 3)
- An emotional control architecture based on appraisal theories of emotion [14, 41, 33] provides the competence for agents to react appropriately in a given story-world. Using an **appraisal-based architecture** that considers the lifeworlds of an agent is seen as key to construct emotionally and dramatically believable characters for interactive drama. This paper highlights aspects of our agent architecture that originated from a BDI background (belief, desire, intention [5, 19]) but is gradually transforming towards a behaviour-oriented design [7]. (section 4)
- A context-dependent interpretation of sensations in combination with an annotation of current behaviours allows for easy implementation of the appraisal process for a simple story-world. Phases of behaviour execution and a preliminary implementation of regulatory influences [17, 32] increase the coherence of activity, especially in the case of activity triggered by coping with a situation deemed relevant, which should deliver what the project aims at: comprehensible and diversified plot links. (section 5)

We conclude with sections on related work, concluding remarks and issues relevant to future work.

2 Dramatic Storyworlds

There are several different approaches to adapt narrative to the possibilities of new media. The notion of the **narrative paradox** characterises interactive narrative as *a compromise between authorial control over the story flow and the freedom of interaction allowed for the user*. There are different approaches to addressing the narrative paradox, ranging from plot-driven to character-based approaches [21, 23, 3]. This work lies on the extreme end of character-based endeavours with the aim of creating **dramatic story-worlds**, i.e., *simulations that are inhabited by software actors for the purpose of enacting (one or more out of several possible, not necessarily explicitly anticipated) dramatically interesting plots*.

Situated agents are needed for unconstrained real-time interaction. The ideal would be agents that adapt to changes made by the user, and changes in the environment, while preserving the consistency and coherence of their own actions according to their role and personality [33]. This work currently focuses on the interaction between the agents themselves and, for now, all but neglects the interaction with the user of the system, although we are considering several styles for interacting with the simulation, from high-level control of an actor

to influence through the manipulation of the environment. ActAffAct, thus, at present is a system for online generation of simple plot pieces, with the longer-term aim of realising **reusable roleplayers**.

To our mind, the decisive factor in this type of synthetic characters is the operationalisation of a model of emotion, as emotions are the essence of a story [12] and play a central role in engaging drama. The conflicts between the characters in a play and the emotions involved in resolving them are the constituents of a dramatic structure, a **plot**, i.e., a constructed rationalisation of the arrangements of incidents in drama ("a plot always serves to shoot a bullet into someone's back"[3]). **Drama** is described as the art that deals with a refined version of emotional interaction between individuals [45, 11]. Confer also the analysis of emotion on the "molar" level in [44] as **core relational themes** that resemble distilled versions of plot elements in drama theory.

Story-worlds present themselves to the single agent as inherently social domains, as social interaction is crucial for the solving of dramatic conflicts. In the ideal case, the author of such a story-world would be able to shift from today's straight jacket of having to specify exact sequences of actions to the authoring of possible behaviours and activities, regularities in the environment, and the setting up of an initial constellation of characters endowed with particular personality traits. While the latter in all likelihood would not be an easier process of authoring, it could open the door to a more flexible, and user-driven, experience of dramatic structures.

The importance of emotion for (interactive) narrative is widely recognised [30, 9, 24], the focus varying from the role of expressive behaviour to convey character state to the motivational influence of emotional evaluations. Our own approach positions emotional processes as the central element for adaptive behaviour in a dynamic story-world that allows for emergent plots. The following section describes these processes in the context of the control architecture of characters.

3 An Apppraisal-based Architecture for Situated Characters

For the design of our synthetic characters, the first and foremost property to consider is **situatedness**—meaning *the predicament of being in a world*. This implies that a character has to obey the spatial and temporal conditions of the (simulated) world, but it also entails that it can exploit what the environment does for it. Further, it means that such an agent can not choose not to act, so there is no need to continuously control the agent on a low level of single actions where its behaviour is already structured by the needs of situated activity and routine functioning [4]. Section 4 provides more detail on our derived conceptualisation. The main problem for a character then is the allocation of its bounded resources to the arbitration of behaviour [42].

[3] Frank Nack, personal communication 2005-05-03

To analyse the actually possible and necessary behaviours we use the concept of a **lifeworld** [1], to enrich the notion of an environment by focusing on the *patterned ways in which a physical environment is functionally meaningful within some activity* [1, p.114]. Such a lifeworld analysis can be leveraged not only to restrict the complexity of the agent-environment interactions (as necessary in a simulation), but also to identify relevant regularities during design. In the case of emotional interaction, the analysis of the **social lifeworld** [37] enacted by agents uncovers the relevant interactions and stresses the requirement for awareness of social relationships in agents.

In [1], the authors identify the lifeworld with abstract locatedness and functionally significant relationships grounded in the physical environment. Analogously, social lifeworld analysis considers the potential for *inter*-action with respect to loci of control at the macro level (e.g., power and status [22]) as well as indirect access to (second and higher level) resources (e.g., [2]). The enactment (or *performance*) of the social lifeworld is the sphere of activity that is dominant in the context of dramatic interactions.

In order to recognise the current and future opportunities and threats of a situation, agents employ a constant evaluation of their surroundings according to their individual **concerns**. The notion of concern, defined as subjective *disposition to desire occurrence or nonoccurence of a given kind of situation* [14, p.335], is related to—but distinct from—those of goals and motives, as the latter terms induce connotations of activity control. Concerns range from very concrete considerations—i.e., relating to an agent's immediate tasks—to abstract ones—such as feeling competent—that can lie dormant until an emotionally pertinent event takes place. Emotional processes—ranging from raw affect under rough and undifferentiated circumstances, over fleets of feelings in (yet) unclear scenarios, to fully articulated "emotions proper" as results of detailed perception—mediate the translation between the subjective worlds of concerns and preferences, the current state of activity in the abstract enacted shared social lifeworld, and the status and offerings of the physical world [37]. Appraisal theories of emotion [14, 41, 33] describe these evaluative processes searching for subjective significance. In ascribing meaning to sensed changes they engender plots and thus allow appropriate responses.

The process of appraisal is often described as a range of checks according to general criteria such as conduciveness, standard compliance, intrinsic pleasantness, novelty, responsibility, and coping potential. Some theories assert a specific temporal, even sequential, organisation of these evaluations of stimuli [40] in humans.

The next sections discuss the abstract model of how we fit the described notions into a situated agent architecture and how the implementation of a simple storyworld with four archetypal characters in ActAffAct realises simple appraisal and coherent behaviour.

4 The Arbitration of Behaviour

A single **action** (actuating or sensing action) is the basic unit of an agent's executive. As mentioned in the previous section, such action is always embedded in a structured **behaviour**, a *compound action that can run in parallel with others and in an unsupervised fashion*. This ansatz parallels the ideas put forware in, e.g., [6] and [24], of a compromise between plan-like structuring of action and a completely parallel architecture, often using intermediate levels of action patterns.

In accordance with the idea of lifeworlds, we think of all behaviours as embedded in **activities**, *the broader context of what an agent is currently doing*. The activities of an agent are generally not goal-directed but only provide *usual* behaviours or behaviour sequences. Examples of such an activity could be to "lead a conversation" or "to go shopping" with typical more goal-directed behaviours such as "acquiring an information" or "acquiring a specific item". Other typical behaviours sustain the current activity: "turn-taking nods", "small-talk", "scanning a shelf", or "checking the shopping list" during shopping.

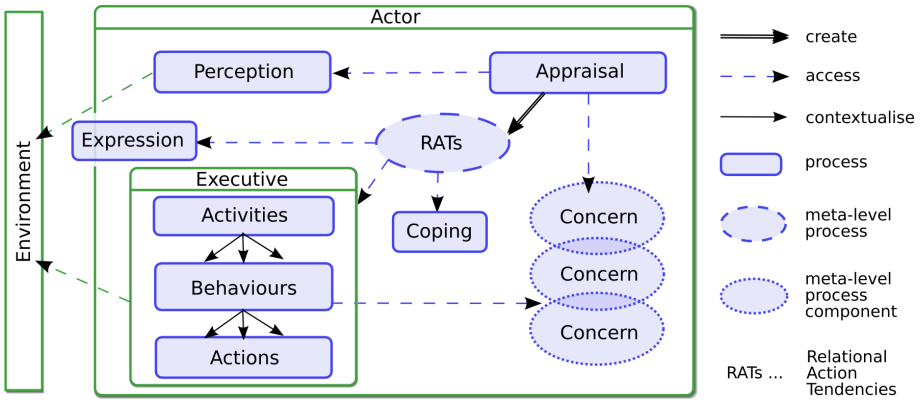

Fig. 1. Conceptual diagram of the appraisal-based agent architecture. The Perception, Expression, and Coping processes all fall into the realm of the Executive; they are singled out due to their special importance

Figure 1 shows a conceptual diagram of the appraisal-based agent architecture. The **Executive** captures the structure of situated activity. The process of **Appraisal** covers the interpretation of perceived changes. **Perception** is the process *translating outside information to inside information*. It fills in **situational meaning structures**, i.e., *subjective modes of appearance of a situation* [14, p.190] by applying a mapping which normally is not unambiguous (and thus e.g. open to *reappraisal*). Note that the resulting possibility of misunderstandings between agents is a desideratum for dramatic plots.

Identification of concern-relevant changes is followed by the creation of a **relational action tendency** (RAT). This term denotes a *state of readiness to achieve or maintain a given kind of relationship with the environment* [14, p.70f]. A situation-driven (and not a goal-oriented) meta-level process, it tries to (re)configure the current activities and behaviours. Furthermore, RATs are manifested in unconditional affective Expression and thereby directly observable by other agents [38], a prerequisite for social awareness. If the current activities do not fit the needs of an action tendency, it may remain inconsequential unless problem-directed **coping** activities adopt the originating appraisal because of RAT's intensity and instigate new goal-directed behaviour.

Another important part of an appraisal-based agent not represented in the diagram are regulation strategies [17, 32] that influence the appraisal and coping processes. Regulation comprises, e.g., cultural and individual display rules (including specification of circumstances when to allow, or even fake emotions) and mood-dependent influences.

It is a big step from the qualitative and partial appraisal theories to an actual implementation. Several efforts investigate agent architectures that incorporate ideas about emotions [20, 13, 43, 16, 28]. Our architecture uses ideas from TABASCO [34]; the implementation effort has been based on JAM, the Java Agent Model [19]. A BDI architecture, JAM provides a plan representation language, goal- and event-driven (i.e., proactive and reactive) behaviour, a hierarchical intention structure, and utility-based action selection. The architecture was extended and, in some cases, its flexibility restricted to fit our needs.

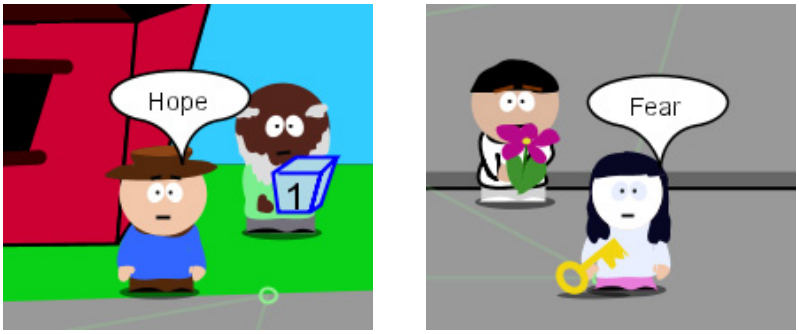

Fig. 2. The cast of ActAffAct: hero & mentor (left), villain & victim (right)

For our simple story-world we built a simulation including a graphical representation of an environment inhabited by four agents, taking on the roles of **narrative archetypes**: a hero, a mentor, a villain, and a victim (Fig. 2). To provoke dramatic conflict, the agents are initialised with conflicting high-level concerns and the social lifeworld is filled with entities suitable for enacting and resolving said conflicts. Concerns include "to be loved by someone" and "to be

mean to lovers", examples of dramatic entities—besides the agents themselves—are pieces of a puzzle (as carried by the mentor in Fig. 2), a flower (stolen by the antagonist), and the key to a treasure (next to the victim).

5 Appraisal Made Easy and Coherence of Behaviour

In order to facilitate a tractable implementation of appraisal in the toy-world of ActAffAct, a simple way to relate current behaviours to an agent's changing concerns is needed: Behaviours are categorised as either trying to *achieve* something, *helping* others to achieve, or *hindering* them from achieving something. This reduces a part of the task of cognitive appraisal—namely assessing the relevance of a percept to some of one's own current goals—to simple pattern matching (although more complex forms of relevance assessment are possible and desirable). The same holds for evaluation of the conformance of an action to the standards of an agent (e.g., the social norms), as these are expressed in terms of desired and undesired behaviours as well. This simple categorisation of behaviours indicates the kind of social commitment they introduce, and allows the matching of sensory data, i.e., they provide situational meaning stucture frames.

Filling of these situational meaning structures is facilitated by the interpretation of current sensory data via plan-like structures that translate the outside into inside information (=beliefs), taking the agent's current context into account. An example at a low level is asserting that an object sensed near the agent is reachable by it, but may range all the way to interpreting the picking up of a flower by the agent next to itself as the anticipated possibility of being offered a present, thereby forming an expectation. These structures parallel what [46] call programmable perception, in our case using information about an agent's current activities. Our implementation circumvents the social credit assignment problem by using custom-built interpretations that assign a responsible agent for every perceived action in the world. These use only using minimal knowledge of causal structures [27], and sometimes rely directly on high-level percepts from the simulated world.

In order to ensure overall coherence, execution of behaviours has often been split into three phases, of which the first and last are harder to interrupt, simulating commitment to one's intentions (in contrast to utility-driven control that might drop just-started behaviours as well as ones near successful completion). A timed pattern influences execution depending on the level of completion. Further, a simple approach of aggregating a mood level from the history of recent appraisals is used to regulate the selction and execution of behaviours to enhance coherence.

The intensity of the outcome of an appraisal of a perceived and interpreted fact is expressed numerically and compared against a threshold: in case of exceeding that value, it instigates coping of this situation, and the agent's appraisal is expressed. Expressive actions that indicate an agent's emotional state are in turn perceived and interpreted by other agents and trigger appraisals.

Coping may introduce new activites. It is the main source of variation in generated plots. Coping activities motivate action that, by way of the emotion process, is causally related to percepts and concerns of the agent. They use the information made available by the appraisal of an event to decide on a suitable course of action to tackle the subjective interpretation. Overall, this provides for the causal relations needed for a dramatic plot.

ActAffAct's simulated domain was tested with different setups of the four characters, one of which excluded the antagonist and thereby the main source of conflict. In the no-conflict case the resulting interactions of the characters, not surprisingly, do not deserve to be called dramatic. A qualitative evaluation of the scenario with the full cast, however, leads us to believe that minimal storylines can indeed be generated using our approach. A quantitative evaluation was not yet pursued as this would require a measure of "story-ness" for the comparison of generated sequences of action, a complex research problem on its own [10]. Even so, our approach shows that a rather simple appraisal-based architecture can yield reasonable outcomes in the distinctively social domain of dramatic interaction.

6 Related Work

Several recent projects that include simulated worlds target the area of interactive narratives in a wide sense [26, 31, 8, 24], others pursue pedagogical applications [25, 29]. As stated above, ActAffAct is designed taking the rather extreme viewpoint on the narrative paradox that external control can be reduced substantially without abandoning the claim of dramatically appropriate interactions. The crucial point is, to our mind, the reliance on emotional processes to provide the causal structure of action sequences.

EMA [16] is a framework for modelling emotion that tries to be domain-independent by harnessing concepts from appraisal theories of emotion. In EMA, coping is defined as inverse operation of appraisal, i.e., the identification and influencing of the believed causes for what has been appraised as significant in the current context. The main focus of development currently lies on extending the range of coping strategies (e.g., "mental disengagement", "positive reinterpretation", "further assess coping potential", or "planning") as responses to emotionally significant events.

Haunt2 [26] is an attempt to create a game in which AI characters are central to the game experience. It is realised as a "mod" for the Unreal game engine. The goal of the game is to escape a house by influencing other characters indirectly. The dramatic storyline in Haunt2 is predefined, represented as a kind of partially ordered plan used by an explicit AI director to send commands to the different characters while reacting to unexpected moves by the human player. Another implementation of a story-engine that uses an Unreal game engine is described in [8, 9]. The storytelling scenario that is used here is based on a James Bond adventure and assigns the role of the villain to the user of the system.

The actors' roles are formalised in a real-time planning system that continually monitors execution and performs dynamic replanning according to user actions.

The work described in [24] focuses on the combined authoring of behaviour and animation of an interactive character especially with tailoring the artistic effect of the character in mind. Issues of authoring support have been excluded from the scope of ActAffAct.

Another approach is used in **Façade**[4], where the proclaimed goal is interactive drama in a realtime 3D world [31]. In Façade there is also a separate component, external to the story, that arranges story segments ("beats") into a coherent story. The characters themselves act autonomously, but adhere to the constraints of the currently established story context. The ActAffAct project, in contrast, tries to achieve a simpler but similar effect without external control.

7 Concluding Remarks and Further Work

We cannot yet claim to have succeeded in creating a robust generator of narratives and the topic of modes of interactivity also remains to be addressed, nevertheless we think that the approach of using emotional concepts in the control architecture of dramatic characters holds great promises to enrich simulated dramatic story-worlds. Explicit links in terms of appraisals and copings provide the connections between actions that render a plot plausible. Consideration of situatedness simplifies their rooting in the simulated world.

The basic model of our control architecture indicates several points for enhancing character adaptivity further through learning. This includes the step of perception as well as the selection and enactment of coping activities. The same basic architecture is applicable to application scenarios other than the enactment of drama. In further work, we will assess the relation between the complexity of the scenario, i.e., the environment and the details of the task for agents therein, and the necessity, or at least the benefits, of architectural components that realise the processes of appraisal. We currently plan to further improve the simulation of the world (in terms of granularity in space and time) and the explicit regulatory strategies in the agents' control architecture to strengthen behaviour coherence further.

In the context of an effort carried out within the European Network of Excellence HUMAINE[5], a broader survey work and steps towards a principled approach for the integration of affective processes, deliberation, and situated action in viable agent architectures are being undertaken. The long term goal is to clarify the systematic relation between the complexity of an environment including its social characteristics—i.e., the social lifeworld—and the characteristics of agent control architectures that such an environment warrants for agents to fulfil specific functions, such as generating believable dramatic plots.

[4] http://www.interactivestory.net/#facade (last visited on 2005-05-01)
[5] http://emotion-research.net (last visited on 2005-05-01)

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