OFAI

Österreichisches Forschungsinstitut für /
Austrian Research Institute for /
Artificial Intelligence

● Freyung 6/6 ● A-1010 Vienna ● Austria ●

● Phone: +43-1-5336112 ●

● `mailto:sec@ofai.at` ●

● `http://www.ofai.at/` ●

O F A I

Österreichisches Forschungsinstitut für /
Austrian Research Institute for /
Artificial Intelligence

TR–2005–02

Stefan Rank, Paolo Petta

Motivating Dramatic Interactions

The Austrian Research Institute for Artificial Intelligence is supported by the
Federal Ministry of Education, Science and Culture.

Motivating Dramatic Interactions

Stefan Rank*

*Austrian Research Institute
for Artificial Intelligence
Freyung 6/6, A-1010 Vienna, Austria
stefan.rank@ofai.at

Paolo Petta*†

†Dept. of Medical Cybernetics and Artificial Intelligence
of the Centre for Brain Research
at the Medical University of Vienna
Freyung 6/2, A-1010 Vienna, Austria
paolo.petta@meduniwien.ac.at

Abstract

Simulated dramatic story-worlds need to be populated with situated software agents that act in a dramatically believable way. In order to provide flexible roleplayers, agent architectures should limit the required external macro-level control. We present work on an architecture that exploits social embedding and concepts from appraisal theories of emotion to achieve the enactment of simple cliché plots. The interplay of motivational constructs and the subjective evaluative interpretation of changes in an agent's environment provide for the causal and emotional connections that can lead to the unfolding of a story.

1 Introduction

This work is part of the ActAffAct project (Acting Affectively affecting Acting (Rank, 2004)) that researches a bottom-up approach to imitating emotional characters that interact in a story-world. The goal is to achieve the unfolding of a plot-like structure while limiting the use of external macro-level control—as exerted by, e.g., a director. The ideal level of external control would be none at all, resulting in the emergence of plot from the characters' interaction, effectively turning the agents into reusable roleplayers. The question that arises is what are the **motivating elements** in the control architecture of synthetic characters that can provide for a dramatically appropriate sequence of actions. Our approach views emotions—as described in appraisal theories (Frijda, 1986; Scherer et al., 2001; Ortony, 2003)—as the links between actions that render a plot plausible.

Emotions are the essence of a story (Elliott et al., 1998) 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. **Drama** can be described as the art that deals with a refined version of emotional interaction between individuals (Vogler, 1996; Egri, 1946). These ideas provide a starting point and can serve as success criteria for the creation of **dramatic story-worlds**, i.e., simulations that are inhabited by software agents for the purpose of enacting dramatically interesting plots. These worlds present themselves to the single agent as inherently social domains, as social interaction is often crucial for solving problems. In the ideal case the author of such a story-world would be able to shift from today's specification of exact sequences of actions to the authoring of possible actions, regularities in the environment, and the setting up of an initial constellation of characters, including their general traits. This would not necessarily be an easier process of creation but it could lead to a more flexible, and possibly user-driven, experience of dramatic structures.

Using an **appraisal-based architecture** that considers the social and physical lifeworld of an agent is seen as key to construct emotionally and dramatically believable characters for interactive drama. This paper highlights aspects of our extensions to a BDI architecture (belief, desire, intention (Bratman et al., 1988; Huber, 1999)) that are pertinent to motivating dramatic actions in a minimal version of a cliché storyline. Situated appraisal of all percepts, a three-phase model of behaviours, and varied coping behaviours have been our first steps towards character-based narrative.

2 Enacting the Social Lifeworld You are Embedded In

Contrary to its physical surroundings, the intangible **social lifeworld** an agent is embedded in has to be continually enacted and negotiated. We use the term social lifeworld in the tradition of Agre and Horswill's analytic endeavour (Agre and Horswill, 1997) to thicken the notion of environment. Our focus on sociality combines the goal of reducing the cognitive load for individual entities populating the environment with emphasising the relevance of coordinative functions (Clancey, 1999) mediating between an individual and the (potential) current and future opportunities and threats to satisfy an individual's **concerns** (Frijda, 1986).

The notion of concern is defined as subjective disposition to desire occurrence or nonoccurence of a given kind of situation. This definition, taken from (Frijda, 1986), is related to but distinct from 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. The process of appraisal is described as a fast and possibly only partial evaluation of subjective significance of changes in the environment according to specific criteria.

By operationalising these theoretical notions, we de-emphasise the role of high-level cognition ("thinking") in routine functioning (Bargh and Chartrand, 1999) and recognise the opportunity offered by available structures to constrain high-level function within tractable bounds. Agre and Horswill (1997) identify 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 (Kemper, 1993)) as well as indirect access to (second and higher level) resources (e.g., Aubé, 1998).

A situated agent's dependence on **regularities** thus extends beyond the physical world into socio-cultural constructs, whose maintenance can e.g. be modelled as an interplay of conventions (social norms) and evaluative processes (emotions) (Staller and Petta, 2001), with emotions sustaining social norms, and culturally defined social norms in turn shaping and regulating emotions (e.g., with feeling rules defining which emotions are suitable in which situation, and display rules providing repertoires of how to express them).

Interpretations of situations and developments in the social lifeworld are not a given: both within an individual and in the society, they are the outcome of negotiations and transactions, captured e.g. in sociological models (Kemper, 1993) or characterised in terms of personality traits. Purposeful functions such as threatening, sanctioning, and amending, therefore are intrinsic behavioural requirements, along with their affective grounding in the social lifeworld. Emotional processes (ranging from raw affect under rough and undifferentiated circumstances, over fleets of feelings in (yet) unclear scenarios, to fully articulated "emotions" as result of detailed perception) mediate the translation between the subjective worlds of states, concerns and preferences, the abstract enacted shared social lifeworld, and the status and offerings of the physical world.

The enactment of the social lifeworld is the sphere of activity that is dominant in the context of dramatic interactions. The mechanisms of emotional processes for interpreting and sustaining this lifeworld and their influence on motivation form a fertile ground for drama.

3 Appraisal-based Architecture

It is a big step from the qualitative appraisal theories to an actual implementation. Several theoretical efforts investigate agent architectures that incorporate ideas about emotions (Isla et al., 2001; Frankel, 2002; Sloman and Scheutz, 2002; Gratch and Marsella, 2004; Marinier and Laird, 2004). The architecture we implemented uses ideas of TABASCO (Petta, 2003), the implementation effort has been based on JAM, the Java Agent Model (Huber, 2001). As 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.

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, an antagonist, a mentor, and a victim (Figure 1). To provoke dramatic conflict, the agents are initialised with conflicting top-level goals (as a first approxima-

Figure 1: Four characters in ActAffAct

tion of concerns) and the social lifeworld is filled with entities suitable for creating and resolving said conflicts. The top-level goals include "being loved by someone" and "being mean to lovers", examples of dramatic entities—besides the agents themselves—are a flower; a sword; and the key to a treasure. The JAM model was adapted for concurrent execution and asynchronous interaction with this world. Apart from these surface changes, the architecture needed to be extended to support appraisal of perceptions in relation to the current goals of the agent, as these are the motivating structures in JAM. Furthermore, our use of plans in JAM was specifically tailored to the needs of an appraisal-based agent. As described in the next section, we restricted the flexible hierarchy of plans in JAM's intention structure to defined levels and implemented a further type of plan suitable for a situated perception process. Percepts are represented as JAM facts; as part of the appraisal process, however, they are reinterpreted by the agent according to its situated context.

According to the revised OCC model (Ortony, 2003) that incorporates more of the elements as discussed in e.g. Frijda (1986), appraisal is based on goals, standards, and preferences of the individual. The latter two are missing in JAM as explicit entities, but can be represented as beliefs. A separate appraisal component was added in the sequential execution cycle of the agent to perform the constant evaluation of percepts. The next section discusses in more detail elements of this ar-

chitecture and their pertinence to appraisal and to motivating believable behaviour in a character.

4 Motivating Elements

Among our changes to the BDI model of JAM are the following additions and restrictions:

- **Perceptions plans**:

  These restricted plans are executed for matching percepts when they are first perceived. They implement the situated reinterpretation of percepts, translating from an agent-neutral representation to one that takes the agent's current context into account, and can range from asserting that an object near the agent is reachable to interpreting the picking up of a flower by the agent next to me as the anticipation of the possibility of being offered a present, thereby forming an expectation.

  This interpretation in the current context can be seen as the first step of appraising the significance of an event. It already takes into account components necessary for the social aspect of appraisal, such as determining the agent reponsible for a specific change.

- **Plan levels**:

  The space of plans accessible to an agent is structured in a hierarchy, starting from *concerns* at the top level, longer-term *activities*, and *behaviours*, to simple *action packages* and plans dedicated to executing a single *act*. This restriction in the use of hierarchy in JAM was chosen as plans of a given level share characteristic patterns. Behaviours in particular have been specifically designed to allow a simple and tractable implementation of appraisal. They are categorised as either trying to achieve something, helping somebody else to achieve something, or hindering them from achieving it. This reduces a part of the task of cognitive appraisal—namely assessing the relevance of a percept to one's own goals—to simple pattern matching (although more complex forms of relevance assessment are possible and desirable). The same holds for assessing the conformance of an action to the standards of an agent, e.g., the social norms, as these are expressed in terms of behaviours as well.

- **Behaviour phases**:

  Furthermore the execution of behaviours has been split into three phases of which the first and the last one are hard to interrupt, in order to simulate commitment to one's intentions. (In contrast, the utility-driven reasoning of JAM might possibly drop a just-started behaviour as well as one that is near its successful completion). A timed pattern was used for behaviours that influences the execution depending on the level of completion. In current work on regulatory influences on plan execution this capability is considered as part of a meta-level plan.

- **Expression and coping plans**:

  If the numerical intensity of the appraisal of a perceived and interpreted fact exceeds a certain threshold value it creates a goal to cope with this situation and another one to express the agent's state. Expressive actions that indicate an agent's emotional state are in turn perceived and interpreted by other agents and trigger appraisals. This signalling of the current emotional state of an agent thus serves the purpose of revealing the elicitation of an emotion directly to others that are watching (Reisenzein, 2001). Coping introduces new top-level goals that are 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. These plans 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, cannot be described as 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 "storyness" for the automatic comparison of generated sequences of action, a complex research problem on its own (Charles and Cavazza, 2004). Even so, our approach shows that rather simple emotional

extensions of a BDI architecture can yield reasonable outcomes in the distinctively social domain of dramatic interaction.

5   Related Work

Several recent projects that include simulated worlds target the area of interactive narratives in a wide sense (Magerko et al., 2004; Mateas and Stern, 2002; Cavazza et al., 2002), others pursue pedagogical applications (Machado et al., 2001; Marsella et al., 2000). A common problem of both types is the **narrative paradox**, the need to balance the flexibility of such a world with the control about narrative flow. As stated above, ActAffAct is designed taking the rather extreme viewpoint 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 (Gratch and Marsella, 2004) 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 (Magerko et al., 2004) 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.

A similar approach is used in **Façade**[1], where the proclaimed goal is interactive drama in a realtime 3D world (Mateas and Stern, 2002). Its public release is (at the moment) announced for spring 2005. In Façade there is also a separate component, external to the story, that arranges

---

[1]http://www.interactivestory.net/#facade

story segments ("beats") into a coherent story. The characters themselves act autonomously but adhere to the constraints of the established current story context. The ActAffAct project, in contrast, tries to achieve a simpler but similar effect without external control.

6 Conclusion And Further Work

Although we cannot yet claim to have succeeded in creating a robust generator of narratives, we nevertheless think that the approach of using emotional concepts in the control architecture of dramatic characters holds great promises to enrich dramatic story-worlds. We currently plan on integrating explicit regulatory strategies into the control architecture of the agents. The main focus of the effort to implement emotion regulation is to strengthen the coherence of a single agent's actions over longer time periods. In the context of an effort carried out within the European Network of Excellence HUMAINE[2], 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.

Acknowledgments

References

URLs mentioned in footnotes or references have last been visited on 2005-01-12.

P. Agre and I. Horswill. Lifeworld analysis. *Journal of Artificial Intelligence Research*, 6:111–145, 1997.

M. Aubé. A commitment theory of emotions. In L. Cañamero, editor, *Emotional and Intelligent: The Tangled Knot of Cognition, Proc. of 1998 AAAI Fall Symposium, Orlando, FL, USA*, pages 13–18, 1998.

J. Bargh and T. Chartrand. The unbearable automaticity of being. *American Psychologist*, 54 (7):462–479, 1999.

M. E. Bratman, D. J. Israel, and M. E. Pollack. Plans and resource-bounded practical reasoning. *Computational Intelligence*, 4(4):349–355, 1988.

M. Cavazza, F. Charles, and S. J. Mead. Character-based interactive storytelling. *IEEE Intelligent Systems*, special issue on AI in Interactive Entertainment 17(4):17–24, 2002.

F. Charles and M. Cavazza. Exploring the scalability of character-based storytelling. In N. e. a. Jennings, editor, *Proceedings of the third International Joint conference on Autonomous agents and multiagent systems (AAMAS'04), July 19-23, 2004, New York City, NY, USA, IEEE Computer Society*, volume 2, pages 872–879, 2004.

W. Clancey. *Conceptual Coordination: How the Mind Orders Experience in Time*. Lawrence Erlbaum Associates, Mahwah, New Jersey, London, 1999.

L. Egri. *The Art of Dramatic Writing*. Touchstone Book, New York, 1946.

C. Elliott, J. Brzezinski, S. Sheth, and R. Salvatoriello. Story-morphing in the affective reasoning paradigm: generating stories semi-automatically for use with "emotionally intelligent" multimedia agents. In K. P. Sycara and M. Wooldridge, editors, *Proceedings of the second international conference on Autonomous*

---

[2]http://emotion-research.net

agents (Agents98) St.Paul, MN, USA, pages 181–188. ACM Press, New York, 1998.

C. B. Frankel. Toward the nature of animation: An architectural approach. In *Proceedings, AISB 2002, Society for the Study of Artificial Intelligence and the Simulation of Behaviour*, London, England, April 2002.

N. Frijda. *The Emotions*. Cambridge University Press, Paris, Editions de la Maison des Sciences de l'Homme, 1986.

J. Gratch and S. Marsella. A domain-independent framework for modeling emotion. *Cognitive Systems Research*, 5(4):269–306, 2004.

M. J. Huber. JAM: a BDI-theoretic mobile agent architecture. In O. Etzioni, J. Mueller, and J. Bradshaw, editors, *Proceedings of the third annual conference on Autonomous Agents*, pages 236–243. ACM Press, Seattle, WA, USA, 1999.

M. J. Huber. *JAM Agents in a Nutshell*. Intelligent Reasoning Systems, Oceanside, CA, USA, Nov 2001. URL http://www.marcush.net/IRS/Jam/Jam-man-01Nov01-draft.htm.

D. Isla, R. Burke, M. Downie, and B. Blumberg. A layered brain architecture for synthetic creatures. In B. Nebel, editor, *Proceedings of the 17th International Joint Conference on Artificial Intelligence (IJCAI 2001), Seattle WA USA, August 4-10*, pages 1051–1058. Morgan Kaufmann, San Francisco, CA, USA, 2001.

T. Kemper. Sociological models in the explanation of emotions. In M. Lewis and J. Haviland, editors, *Handbook of Emotions*, pages 41–52. Guilford Press, New York/London, 1993.

I. Machado, P. Brna, and A. Paiva. Learning by playing—supporting and guiding story-creation activities. In J. Moore, C. Redfield, and W. Johnson, editors, *International Conference on AI in Education*, volume 68 of *Frontiers in Artificial Intelligence and Applications*. IOS Press, Amsterdam, 2001. URL http://gaips.inesc.pt/gaips/shared/docs/Machado01LearningByPlaying.pdf.

B. Magerko, J. Laird, M. Assanie, A. Kerfoot, and D. Stokes. AI characters and directors for interactive computer games. In D. McGuinness and G. Ferguson, editors, *Proceedings of the*

19th National Conference on Artificial Intelligence, 16th Conference on Innovative Applications of Artificial Intelligence (AAAI-04), July 25-29, 2004, San Jose, CA, USA, pages 877–883. AAAI Press, Menlo Park, CA, 2004.

R. Marinier and J. Laird. Toward a comprehensive computational model of emotions and feelings. In M. Lovett, C. Schunn, C. Lebiere, and P. Munro, editors, *6th International Conference on Cognitive Modelling (ICCM2004): Integrating Models, July 30-August 1, 2004, Carnegie Mellon University, Pittsburgh, PA, USA, Learning Research and Development Center, University of Pittsburgh*, 2004.

S. C. Marsella, W. L. Johnson, and C. LaBore. Interactive pedagogical drama. In C. Sierra, M. Gini, and J. Rosenschein, editors, *Proceedings of the 4th International Conference on Autonomous Agents, Barcelona Spain, June 3-7 2000*, pages 301–308. ACM Press, New York, NY, USA, 2000.

M. Mateas and A. Stern. Architecture, authorial idioms and early observations of the interactive drama façade. Technical Report CMU-CS-02-198, School of Computer Science, Carnegie Mellon University, 2002.

A. Ortony. On making believable emotional agents believable. In R. Trappl, P. Petta, and S. Payr, editors, *Emotions in Humans and Artifacts*, pages 189–212. MIT Press, Cambridge MA/London UK, 2003.

P. Petta. The role of emotions in a tractable architecture for situated cognizers. In R. Trappl, P. Petta, and S. Payr, editors, *Emotions in Humans and Artifacts*, pages 251–287. MIT Press, Cambridge MA/London UK, 2003.

S. Rank. Affective acting: An appraisal-based architecture for agents as actors. M.S. thesis, Vienna University of Technology, Vienna, Austria, EU, 2004.

R. Reisenzein. Appraisal processes conceptualized from a schema-theoretic perspective: Contributions to a process analysis of emotions. In (Scherer et al., 2001), pages 187–201.

K. R. Scherer, A. Schorr, and T. Johnstone, editors. *Appraisal Processes in Emotion: Theory, Methods, Research*. Oxford University Press, Oxford/New York, 2001.

A. Sloman and M. Scheutz. A framework for comparing agent architectures. In *Proceedings UKCI 02: UK Workshop on Computational Intelligence, Sept 2002, Birmingham, UK*, 2002.

A. Staller and P. Petta. Introducing emotions into the computational study of social norms: A first evaluation. *Journal of Artificial Societies and Social Simulation*, 4(1), 2001.

C. Vogler. *The Writer's Journey: Mythic Structure for Storytellers and Screenwriters*. Boxtree, London, 1996.