

Creativity in Configuring Affective Agents for Interactive Storytelling

Stefan Rank¹, Steve Hoffmann², Hans-Georg Struck³, Ulrike Spierling², Paolo Petta¹

¹ Austrian Research Institute for Artificial Intelligence (OFAI), Austria

stefan.rank/paolo.petta @ ofai.at

² Hochschule RheinMain, University of Applied Sciences, DCSM, Germany

Steve.Hoffmann/Ulrike.Spierling @ hs-rm.de

³ Independent Screenwriter

georgstruck @ foni.net

Abstract

Affective agent architectures can be used as control components in Interactive Storytelling systems for artificial autonomous characters. Creative authoring for such systems then involves configuration of these agents that translate part of the creative process to the system's runtime, necessarily constrained by the capabilities of the specific implementation. Using a framework for presenting configuration options based on literature review; a questionnaire evaluation of authors' preferences for character creation; and a case study of an author's conceptualisation of the creative process, we categorise available and potential methods for configuring affective agents in existing systems regarding creative exploration. Finally, we present work-in-progress on exemplifying the different options in the ActAffAct system.

Introduction

Interactive Digital Storytelling (IDS) is concerned with the creation of a new media art form that allows for real-time interaction with a developing narrative. In the terminology of (Boden and Edmonds 2009), the aim is a form of CI-art or VR-art, i.e., computer-generated and responsive to audience interaction, possibly in the form of virtual reality. Creating new methods for adaptivity, generativity, and interactivity is seen as the prime method for advancing beyond traditional linear media, and while there are recent examples of technical approaches that are close to video-based media, e.g. video recombination (Porteous et al. 2010), and of conceptual approaches to story generation, e.g. based on analogy-mapping (Ontañón and Zhu 2011), a large part of the research has focused on enabling interactive storyworlds inhabited by synthetic characters (Rank 2005; Si, Marsella, and Pynadath 2005; Louchart and Aylett 2007). The assembly of autonomous conversational actors endowed with some degree of autonomy poses significant integration challenges (Gratch et al. 2002), including the development of authoring methodologies that support the creative process inside the boundaries of an IDS system.

We take the point of view of authors with IDS experience to find ways beyond the current disparity between needs of authors and capabilities and interfaces of existing systems. In order to examine the support for creative authoring in these systems, we look at methods for configuring one crucial element for translating parts of the creative process to

runtime: affective agents. After introducing affective agent architectures and a framework for presenting their configuration options to authors that draws on literature review; the evaluation of authors' preferences for character creation using a questionnaire; and a case study of an author's conceptualization of the creative process, we examine available and potential methods for configuring affective characters in existing systems. Finally, we report on work-in-progress translating these options to the ActAffAct system.

Affective Characters

Affective agents are a specialization of intelligent agents for domains in which emotional and related phenomena are important. A key dimension for agent control architectures of synthetic characters is affective competence: believable portrayal of emotional reactions and the capability of selecting appropriate expressiveness; variability within the consistent boundaries perceived as personality (Ortony 2003); and the recognition of subjective relevance in the agent's (social) environment (Marsella, Gratch, and Petta 2010). The origins of such architectures often lie with scenarios of use (Rank and Petta 2006) that target other application areas, cognitive modeling or modeling of psychological theories. Their configuration is not necessarily suited directly for the authoring of synthetic characters.

In the context of IDS, synthetic characters translate parts of the creative decisions of authoring to the runtime system. Affective competence helps to ensure the emotional aspect of character portrayal as well as of the causal connections in a story, down to the fine-grained level of audience interaction. Here, we focus on techniques that model characters and their behaviour *explicitly* in order to achieve levels of motivational and behavioral autonomy that facilitate the generativity and interactive flexibility that IDS strives for. On the spectrum from 'strong autonomy' to 'strong story' (Mateas and Stern 2000; Swartjes 2010), this places the approach towards the autonomy-end, more compatible with the idea of emergent narrative that nevertheless requires purposeful authoring (Louchart et al. 2008), in addition to affective and situated competencies, to be successful. Even in a strongly story-based interactive system, autonomously competent agents are valuable if they can be configured to act 'in character' during episodes that are not directly controlled by a story-based framework or if the system explicitly

represents emotional links between characters as part of the authoring process (Pérez y Pérez 2007). For the context of this work, the top-level of an IDS system, drama management (Roberts and Isbell 2008), is not considered: we intentionally focus on single characters and their autonomous behaviour: *character goals* rather than *author goals* (Riedl 2009).

The nature of interactive systems entails that judgment of creativity cannot focus on novelty and value of static artifacts as for systems that clearly separate a generative part, see also (Gervás 2009): The use of affective agents carries aspects that are clearly separable for static artifacts, such as chronology, causality, and the distinction between fabula and discourse, i.e. what is told and how it is told, into the runtime of a system. Rather, we try to map the conceptual spaces that are established by affect models as well as the ways for exploring and potentially transforming them. This approach is similar to work in the area of game design (Smith and Mateas 2011). In (Spierling and Hoffmann 2010), the authors state that creative authorship is far from obsolete in the context of IDS. The creative output consists to a substantial degree of the specific configuration of the control system. Abstractions at the creative conceptual level are seen to be distinct from the more formal abstractions (Crawford 2004) required for implementation. Rather, this relationship between authorial conceptual abstractions and implementation-specific abstractions of a more technical kind and the special kind(s) of dedicated support required of an IDS system for this transformation needs to be *investigated* for each case.

Configuration Options for Affective Agents

We use a framework for the configuration of affective characters as seen from the author's perspective (Rank et al. 2012), based on feedback received from a questionnaire study performed during an authoring workshop¹, as well as a case study of one author's practice, strongly rooted in drama theory. The questionnaire used free-text feedback and a set of Likert-scale questions intended to gauge the relative importance of different strategies for creating characters for a story-world. The free-text feedback reflected a wide range of approaches to character creation, including placing the focus on events, conflicts, or personality-specific feelings that happen to the character; the reliance on known characters or on personal experience as a starting point; and picking the background and underlying goals of characters as central element. At the same time, the reported results point at the complementarity of different approaches to character creation while the evaluation of preferences for different approaches showed no significant differences at that level of investigation (Rank et al. 2012).

As a second source for authors' viewpoints on the problem of configuring synthetic characters in an effective way, we draw on a case study of the authoring experience of one of the co-authors (Struck 2005) with both traditional linear narratives (i.e., script writing) and interactive story-

¹The IRIS authoring summer school <http://iris.interactive-storytelling.de/Summerschool>

telling systems. The central tenet of this author's experience is the conceptualization of narrative as a *sequence of emotional effects*. Underlying this approach are character-centered drama models based on work such as by Frank Daniel (see (Howard and Mabley 1995)) and the notion of a *conceptual space* (Struck 2005). Furthermore, the practice corresponds to the cyclic process of *engagement* and *reflection* that has been proposed as a model of creativity in writing (Sharples 1999).

As a quick way to concretize a character's role in a narrative, it is proposed to answer the question: What does the character want the most? Motivations and aversions of a character are then considered subordinate to this main desire. The notions of aspirations, vocations, and goals are crucial to derive a character's *fears*. As an example, consider a character that wants to see the world: Potential candidates for suitable high-impact fears would then be fear of flying or fear of crossing open water. A narrative is then seen to pitch a character's goals against obstacles involving the need to risk high stakes. Anything lacking in connection to a character's hopes and fears is omitted. Conversely, everything that is shown relates to this backstory of the character. Note that such constraints quickly extend beyond individual characters to comprise their social stances and interrelationships (Spierling and Hoffmann 2010). In addition, this selection principle contributes to perceived believability by allowing for inference and prediction of motivations and intentions through observations, e.g. (Riedl and Young 2010), p.220.

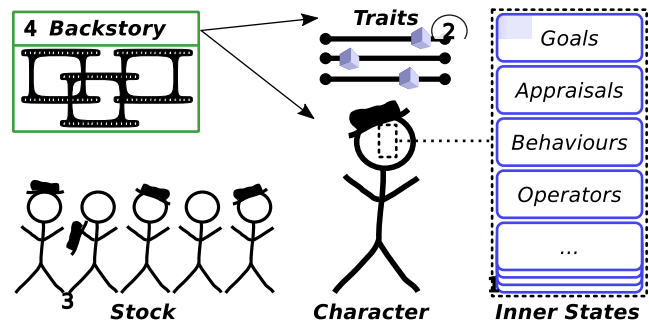


Figure 1: The levels of presenting configuration of characters in IDS.

Based on this investigation of the authors' viewpoint, and considering available systems, four different *non-distinct* levels of presenting configuration are distinguished, as illustrated in Figure 1:

1. Direct changes to initial *inner states* of agents as motivating factors for the character's behaviour.
2. Parameter settings that influence the inner working of an agent in correspondence to a theoretically persistent characteristic of the agent as a whole: *traits*.
3. Complete *stock characters* with a particular personality that can be used as a basis for customization.
4. Configuration based on the selection of *backstory experiences* that influence background beliefs and emotional parameters.

Levels 1 and 2 define a conceptual space that can be explored exhaustively in theory, though not in practice for most systems. Levels 3 and 4, while relying on the same methods of character control, present configuration as a transformational process starting from exemplars². As mentioned, these levels are not distinct and can be seen as complementary, progressing towards a higher level of abstraction.

Configuration in Existing Systems

In the following, we review current systems and their support for exploring configuration in terms of inner states and traits, as well as the potential for supporting stock characters and backstory experiences. An important biasing factor for the selection of example systems was the open or confidential availability of source code.

As mentioned above, the inner states of existing systems are often strongly tied to the origin of the agent architecture and not geared towards authoring. Many affective agent architectures can be seen as extensions of *belief-desire-intention (BDI) agent models* based on ideas about resource-bounded practical reasoning (Bratman, Israel, and Pollack 1988). These ‘BDI+E’ architectures rely on: *beliefs* that represent what an agent holds to be true, *desires* (or goals) that an agent tries to fulfill, and a representation of what the agent is capable of doing, often in terms of a *plan library*. The third name-giving element, *intention*, refers to capabilities activated in pursuit of a current goal. The main influence on agent behaviour that all these architectures share and that are directly amenable to exploration are the relative importance of different desires, i.e. their *utility*, and the set of capabilities available to a specific agent.

Examples of architectures that add an operationalization of *affective appraisal* are FATiMA (Dias and Paiva 2005) or ActAffAct (Rank 2005). The addition of affective appraisal results in further parameters for exploring configurations: the relative importance of standards, i.e. the *evaluation of different types of behaviour*; the initial relative importance of the actors and objects in the storyworld; and the *creation thresholds* and *decay rates* for different types of emotions. Further, such architectures were extended to consider *mood as a meta-level effect*, i.e. as an aggregate of previous emotions. An important additional parameter in this respect is the number of emotions considered. One extension of FATiMA (Doce et al. 2010) applies the so-called OCEAN or five-factor model of personality. An individual’s personality is expressed as values of five *personality traits* that can be used to explore the possible resulting behaviours: openness, conscientiousness, extraversion, agreeableness, neuroticism. The values for the five OCEAN factors influence the appraisal process in terms of thresholds and decay rates for emotion instances, but also coping and planning as well as expressivity in an animation system.

Both the BDI framework and personality theory frame the configuration of agents in terms that are still close to the authorial conceptualization presented above. For other mech-

anisms, the matching of explorable settings is less direct. In implementations based on PSI theory, such as MicroPSI (Bach 2003) or ORIENT (Lim et al. 2012), another extension of FATiMA, emotions are described as sets of modulators that influence processing directly: *arousal*, i.e. the propensity for action, *resolution level*, i.e. the accuracy of internal processing, and *selection threshold*, i.e. resistance to change the current intentions. Exploring the effect of different situations on the values for these modulators opens a space for an agent’s personality. On a more general level, PSI theory introduces the individual settings of so-called *motivators* (affiliation, integrity, energy, certainty, and competence), homeostatic variables with an influence on behaviour based on the deviation from set-points.

Further affective architectures are built on top of cognitive architectures that in themselves provide a wide range of possibilities for configuring individual differences in terms of *inner states*. An example is Soar and the emotion models based on it, such as EMA (short for emotion and adaptation) (Marsella and Gratch 2009) or PEACTION (Marinier and Laird 2006). Soar itself provides a general processing cycle that can be used in different styles, which in turn results in a wide range of configuration options. Corresponding to the BDI approach, the *utility of goals* and the *availability of operators* form the core of any configuration. Similarly, in Thespian (Si, Marsella, and Pynadath 2005; Si, Marsella, and Pynadath 2009), goals, policies and beliefs about self and others are the determining factors of single agent behaviour. In addition, in support of authorial control, characters can be configured by specifying multiple story-paths that are used to deduce their goals. Thereby, this approach employs a strong-story element to parameterize a system that is originally autonomy-driven. In EMA, the overall affective assessment is based on a causal interpretation of the current state of the world. On a conceptual level, the *granularity of this representation* forms an important part of configuring the personality of an agent. One focus of affective architectures in general are coping activities defined as the inverse operation of appraisal. Coping thus involves the identification and influencing of the believed causes for the currently significant state. Different coping strategies can be available to a single agent and the selection of these strategies represents a new level of potential configuration and a suitable candidate for a high-level exploration of the conceptual space of affective agents. Further, *availability and relative priority of different coping strategies* can be linked to backstory experiences.

In the VirtualStoryteller framework (Swartjes, Kruizinga, and Theune 2008), *late commitment* is used for the autonomous characters to determine the values of internal parameters and the state of the storyworld at runtime rather than beforehand at authoring time. To inform these delayed decisions, an assessment of the benefit of available options for story development is computed, thus reducing options of direct authoring of character *states* in favour of more global *traits* of the character in the story context.

Planning and scheduling techniques add further implementation-specific parameters for configuring individual differences that are comparatively far removed

²See (Rook and Knippenberg 2011) on the influence of quality of exemplars on creativity and imitation depending on the regulatory focus of authors.

from the author’s perspective. As an example, planning algorithms can use *quality measures*, e.g., time and cost, and *resource constraints* to decide between alternative paths of action. Configuration of these mechanisms involves relative weighting of different quality measures.

Table 1: Configuration options for inner states and traits.

Inner States	Beliefs, granularity of internal representation; Availability of capabilities; Utility of goals; Standards, evaluation of types of behaviour; Thresholds and decay rates for emotion types; Availability and priority of coping strategies
Traits	History considered for meta-level mood; Qualities/constraints for planning/scheduling; Openness, conscientiousness, extraversion, agreeableness, neuroticism; Arousal, resolution level, selection threshold; Importance of affiliation, integrity, energy, certainty, competence

Table 1 summarizes relevant options for configuration of affective behaviour, distinguishing options related to inner states from traits of the agent as a whole. Practical and intentional examples for stock characters and configuration based on backstory experiences are rare. However, most architectures were designed for a specific purpose and therefore a set of characters is available, at least in principle. To the best of our knowledge, explicit use of backstory experiences to influence individual character behaviour has not been implemented in any system so far.

Extending Configuration of ActAffAct

ActAffAct (Rank 2005) is a proof-of-concept system that relies solely on the affective competences of individual characters and their configuration in terms of *beliefs* and *desires* to generate interesting but very simple plots within an interactive storyworld setting comprising a hero; a villain; a victim; and a mentor, as well as simple props such as a sword; a rope; or a bouquet of flowers. As a system with BDI-background and a practical reasoning system at its core, the modification of *inner states* is the direct way of exploring character designs. The use of a mood-system allows for the modification of *traits*: influence factors of different emotion types on mood and the decay rate of the mood state, that influence the character as a whole. Our work-in-progress considers the support for stock characters and backstory experiences. Due to the use of “cliché” story characters, archetypes, as agents in the original system, a set of stock characters can be derived directly. Most interesting though is the realisation of backstory experiences: The implementation of the appraisal process includes the selection of coping styles and the relative weighting of different types of emotions. These two elements lend themselves to be configured by a selection from automatically generated episodes: every episode shows reactions of a character in the possible combinations of encounters with other characters and objects in the storyworld. Evaluation of the resulting authoring possibilities is planned, including a questionnaire study.

Conclusion

In this paper, we used a conceptualization of character creation from the author’s viewpoint to review different levels of configuration that current affective agent architectures provide. A mapping of notions of the author’s creative process to configuration options is not straightforward. Rather, due to the roots of many affective agent architectures in areas other than IDS, parameters offered for exploration are often far removed from the author’s perspective on character creation. On the other hand, parameters that stem from theoretical and practical considerations in agent architectures potentially provide new sources of creative inspiration for authors, both in terms of details of modeling and in terms of additional factors of influence that implementation-specific configurations expose for exploration. Overall, the conceptualization helps to frame the support for creativity in authoring IDS systems, and points to future extensions of approaches for character configuration. Finally, based on the review of configuration options in related systems, we presented ongoing work in extending the ActAffAct system regarding new ways for configuring autonomous characters.

Acknowledgements

This work is partially supported by the European Commission under grant agreement IRIS (FP7-ICT-231824). The Austrian Research Inst. for AI is supported by the Austrian Federal Ministry for Transport, Innovation, and Technology.

References

- [Bach 2003] Bach, J. 2003. The MicroPsi Agent Architecture. In *Proc.5.Int.Conf.on Cognitive Modeling ICCM-5, Bamberg DE, Apr.10-12 2003*, 15–20. Universitäts-Verlag, Bamberg DE.
- [Boden and Edmonds 2009] Boden, M. A., and Edmonds, E. A. 2009. What is generative art? *Digital Creativity* 20:1–2.
- [Bratman, Israel, and Pollack 1988] Bratman, M. E.; Israel, D. J.; and Pollack, M. E. 1988. Plans and Resource Bounded Practical Reasoning. *Computational Intelligence Journal* 4(4):349–355.
- [Crawford 2004] Crawford, C. 2004. *Chris Crawford On Interactive Storytelling*. New Riders Publishing, Indianapolis.
- [Dias and Paiva 2005] Dias, J., and Paiva, A. 2005. Feeling and Reasoning: a Computational Model. In *Progress in AI, EPIA 2005*, 127–140. Springer LNCS 3808.
- [Doce et al. 2010] Doce, T.; Dias, J.; Prada, R.; and Paiva, A. 2010. Creating Individual Agents Through Personality Traits. In *Intelligent Virtual Agents, 10th Int.Conf. IVA 2010, Philadelphia PA USA, Sep.20-22 2010. Proc.*, 257–264. Springer.
- [Gervás 2009] Gervás, P. 2009. Computational Approaches to Storytelling and Creativity. *AI Magazine* 30(3):49–62.
- [Gratch et al. 2002] Gratch, J.; Rickel, J.; André, E.; Cassell, J.; Petajan, E.; and Badler, N. 2002. Creating Interactive Virtual Humans: Some Assembly Required. *IEEE Intelligent Systems* 17(4):54–63.

- [Howard and Mabley 1995] Howard, D., and Mabley, E. 1995. *The Tools of Screenwriting - A Writer's Guide to the Craft and Elements of a Screenplay*. St. Martin's Griffin.
- [Lim et al. 2012] Lim, M. Y.; Dias, J.; Aylett, R.; and Paiva, A. 2012. Creating adaptive affective autonomous NPCs. *Autonomous Agents and Multi-Agent Systems* 24(2):287–311.
- [Louchart and Aylett 2007] Louchart, S., and Aylett, R. 2007. From Synthetic Characters to Virtual Actors. In *Proc.3.Artificial Intelligence and Interactive Digital Entertainment Conf.*, 88–90. AAAI Press.
- [Louchart et al. 2008] Louchart, S.; Swartjes, I.; Kriegel, M.; and Aylett, R. 2008. Purposeful Authoring for Emergent Narrative. In *Proc.1.Joint Int.Conf.on Interactive Digital Storytelling (ICIDS 2008)*, 273–284. Springer LNCS 5334.
- [Marinier and Laird 2006] Marinier, III, R. P., and Laird, J. E. 2006. A Cognitive Architecture Theory of Comprehension and Appraisal. In *Proc.18.Meeting on Cybernetics and Systems Research, Apr.18-21 2006, Univ. of Vienna*. Austrian Soc.for Cybernetic Studies. 589–594.
- [Marsella and Gratch 2009] Marsella, S. C., and Gratch, J. 2009. EMA: A process model of appraisal dynamics. *Cognitive Systems Research* 10(1):70–90.
- [Marsella, Gratch, and Petta 2010] Marsella, S.; Gratch, J.; and Petta, P. 2010. Computational Models of Emotion. In *A Blueprint for Affective Computing - A sourcebook and manual*. Oxford Univ. Press. 21–46.
- [Mateas and Stern 2000] Mateas, M., and Stern, A. 2000. Towards Integrating Plot and Character for Interactive Drama. In *Working Notes of the Social Intelligent Agents: The Human in the Loop Symposium. AAAI Fall Symposium Series. Menlo Park CA*. AAAI Press. 113–118.
- [Ontañón and Zhu 2011] Ontañón, S., and Zhu, J. 2011. The SAM Algorithm for Analogy-Based Story Generation. In *Proc.7.AAAI Conf.on AI and Interactive Digital Entertainment, AIIDE 2011, Oct.10-14 2011*, 67–72. AAAI Press.
- [Ortony 2003] Ortony, A. 2003. On Making Believable Emotional Agents Believable. In *Emotions In Humans And Artifacts*. MIT Press. 189–212.
- [Porteous et al. 2010] Porteous, J.; Benini, S.; Canini, L.; Charles, F.; Cavazza, M.; and Leonardi, R. 2010. Interactive Storytelling Via Video Content Recombination. In *Proc.18.Int.Conf.on Multimedia 2010, Firenze Italy, Oct.25-29 2010*, 1715–1718. ACM.
- [Pérez y Pérez 2007] Pérez y Pérez, R. 2007. Employing Emotions to Drive Plot Generation in a Computer Based Storyteller. *Cognitive Systems Research* 8(2):89–109.
- [Rank and Petta 2006] Rank, S., and Petta, P. 2006. Comparability Is Key to Assess Affective Architectures. In *Proc.18.Meeting on Cybernetics and Systems Research, Apr.18-21 2006, Univ. of Vienna*. Austrian Soc.for Cybernetic Studies. 643–648.
- [Rank et al. 2012] Rank, S.; Hoffmann, S.; Struck, H. G.; Spierling, U.; Mayr, S.; and Petta, P. 2012. Authoring vs. Configuring Affective Agents for Interactive Storytelling. *Applied AI, to appear*.
- [Rank 2005] Rank, S. 2005. Towards Reusable Roleplayers Using an Appraisal-Based Architecture. *Applied AI* 19(3-4):313–340.
- [Riedl and Young 2010] Riedl, M. O., and Young, R. M. 2010. Narrative Planning: Balancing Plot and Character. *J.of AI Research* 39:217–268.
- [Riedl 2009] Riedl, M. O. 2009. Incorporating Authorial Intent Into Generative Narrative Systems. In *Intelligent Narrative Technologies II, Papers from the 2009 AAAI Spring Symposium*, 91–94. AAAI Press.
- [Roberts and Isbell 2008] Roberts, D. L., and Isbell, C. L. 2008. A Survey and Qualitative Analysis of Recent Advances in Drama Management. *Int.Trans.On Systems Science And Applications* 4(2):61–75.
- [Rook and Knippenberg 2011] Rook, L., and Knippenberg, D. V. 2011. Creativity and Imitation: Effects of Regulatory Focus and Creative Exemplar Quality. *Creativity Research Journal* 23(4):346–356.
- [Sharples 1999] Sharples, M. 1999. *How We Write: Writing as Creative Design*. Routledge London.
- [Si, Marsella, and Pynadath 2005] Si, M.; Marsella, S. C.; and Pynadath, D. V. 2005. Thespian: Using Multi-Agent Fitting to Craft Interactive Drama. In *Proc.4.Int.Joint Conf.on Autonomous Agents and Multi-Agent Systems, Utrecht NL, July 25-29 2005*, 21–28. ACM Press.
- [Si, Marsella, and Pynadath 2009] Si, M.; Marsella, S.; and Pynadath, D. 2009. Directorial Control in a Decision-Theoretic Framework for Interactive Narrative. In *Interactive Storytelling, 2.Joint Int.Conf.on Interactive Digital Storytelling, ICIDS 2009, Guimarães Portugal, Dec.9-11 2009. Proc.*, 221–233. Springer LNCS 5915.
- [Smith and Mateas 2011] Smith, A. M., and Mateas, M. 2011. Knowledge-Level Creativity in Game Design. In *Proc.2.Int.Conf.on Computational Creativity, 27-29 Apr.2011*, 16–21. Univ. Autònoma Metropolitana MX.
- [Spierling and Hoffmann 2010] Spierling, U., and Hoffmann, S. 2010. Exploring Narrative Interpretation and Adaptation for Interactive Story Creation. In *Interactive storytelling: 3.Joint Conf.on Interactive Digital Storytelling, ICIDS 2010, Edinburgh UK, Nov.1-3 2010. Proc.*, 50–61. Springer LNCS 6432.
- [Struck 2005] Struck, H.-G. 2005. Telling Stories Knowing Nothing: Tackling the Lack of Common Sense Knowledge in Story Generation Systems. In *Virtual Storytelling - Using VR Technologies for Storytelling, 3.Int.Conf.(ICVS 2005), Strasbourg FR, Nov.30-Dec.2 2005. Proc.*, 189–198.
- [Swartjes, Kruizinga, and Theune 2008] Swartjes, I.; Kruizinga, E.; and Theune, M. 2008. Let's pretend I had a sword: late commitment in emergent narrative. In *Proc.1.Joint Int.Conf.on Interactive Digital Storytelling (ICIDS 2008)*, 264–267. Springer LNCS 5334.
- [Swartjes 2010] Swartjes, I. 2010. *Whose story is it anyway? How improv informs agency and authorship of emergent narrative*. Ph.D. Dissertation, Univ. of Twente NL.