

# Narrative Theories as Contextual Constraints for Agent Interaction

John F. Meech

Network Computing Group  
Institute for Information Technology  
National Research Council of Canada.  
Montreal Road, Ottawa, Ontario, Canada. K1A 0R6  
John.Meech@iit.nrc.ca

## Abstract

This paper presents the view that narrative may be viewed as a framework for situating interaction (or the distribution of knowledge) in a particular context. The process of constructing this context explicates both interaction and knowledge exchange. Narrative techniques can therefore be placed within a framework for providing contextualization in agents to enhance user interactions, and this, in turn, can be used to inform the design of agent interaction and interactive narratives.

## Context and Contextualization

The paradigm-shift from computer-as-tool to computer-as-communicator in human-computer interaction emphasises the importance of context in constraining interaction, as context may be thought of as the environment that allows an intended meaning to be correctly ascribed by the communicators. Cooper (1991) emphasises the ability of people to actively construct such an underlying reality in order to resolve contradiction and inconsistency. In communicating, the dialogue partners actively construct context (i.e. establish shared plans, shared knowledge, etc.) - there is no guarantee how much sharing will take place; context is as much a dynamic contest as a static goal. This process can therefore be viewed as a *process* of *contextualization* (Edmondson and Meech, 1994). Mittal and Paris (1993) identify the following as components of context:

1. The problem solving situation (the Tasks),
2. The participants involved (expertise, beliefs, goals, etc.)
3. The mode of interaction in which communication is occurring,
4. The discourse taking place,
5. The external world.

Using these factors, context has been used in the design of adaptive interfaces with the motivation of improving the task-to-tool mapping and subsequently improve interaction (Croft, 1984). Here it is important to recognise that *adaptation* refers to the ability of the system to *act appropriately in a given context*. However, this conception

of context is static and scope is already constrained by an implicit context, usually represented by a task (Tyler and Treu, 1989). For example, in Croft's work the ability of the interface to adapt successfully is because the behaviour of the system is already anticipated by the user. (e.g. as "edit", "form filling", "email" or "calendaring"). This is because the user has recognised the next (higher) level of context is "office tasks", and they know what it is possible to do in this context.

Agent-based user interfaces essentially duplicate the functionality of intelligent and adaptive user interfaces, the change in terminology reflecting a change in paradigm rather than a change in goals. This paradigm emphasises the move towards active, autonomous support architectures, and brings with it a series of concerns relating to the characteristics which these agent interfaces appear to the user. These agents can take on many roles, adopting a range of human social conventions for the tasks they perform and the way they relate to the user. These roles can be summarised as follows (See also Mase, 1997; Wilson, 1997; Bickmore et al., 1998):

**Gurus** - The agent performs some reasoning (possibly prompted by the user) and supplies the results.

**Colleagues** - The user and the agent negotiate about the issue under consideration in a way similar to consulting a colleague (co-worker) for an opinion.

**Assistants** - *Secretary Agents* or *Guides*; These agents allow delegation of tasks from the user, necessarily including elements of Guru and Colleague.

**Autonomous Personal Representatives** - Agents that "stand in" for the user. They may express a user's point of view, give guided tours, presentations, or represent the user's opinions (including elements of personality). Avatars (virtual physical representations) are included in this category.

**Companions** - Agents that exist as believable social entities (including virtual pets).

**Entertainers** - Agents which entertain (e.g. *Actors* in Virtual Theatre).

The communicating agent model implies that the system behaves intelligently, and consequently the responsibility

for recognising what the system can or cannot do, when and how to act, etc. is shared between the agent and the user. The important question now concerns the scope of context and contextualization that an agent should take into account when communicating with a user. This classification of agent types indicates that the criteria include contextual elements (such as social attributes, personality, degree of autonomy in relation to the user - e.g. degree of delegation, etc.). Many of these elements are outside the scope that is normally recognised as providing context. Brown and Duguid (1994) term these *border resources*. These socially shared, dynamic resources become established *genres* over time.

“These genres are socially constructed interpretative conventions that bridge the two sides of a communication. ...on one side producers – architects, authors, designers, speakers and the like – try to invoke a particular genre to establish the conventions that they are putting into play.” p10

For example, calling a movie a “thriller” places it into an established genre and consequently establishes a recognisable context. The previous taxonomy of agent types encompasses a wide range of social and communicative abilities. To provide the abilities to enable an agent to contextualize in the widest sense, the agent will need resources based on the following factors:

1. The external world (the situated context)
2. The set of goals and tasks (the focal context)
3. A model of the user (preferences, etc. – the user context)
4. The form of dialogue (elements of agent role and social context)
5. The representation of the dialogue (physical representations of context).

A model of the external world enables border resources to be used when available, and enables other non-task related factors to be used (e.g. social cues). The tasks, goals and user model enable shared context to be established as contextual process through dialogue. The dialogue itself also has elements of concerning social factors (e.g. the degree of initiative the agent is expected to take), coupled with how the dialogue is rendered (e.g. as speech, text, graphics, etc.). Notice that all of these categories have elements connected with social characteristics of the agent. e.g. the representation of the dialogue, even as speech, can be given intonation and gender characteristics which may influence the way the communication is perceived by the recipient. Many of these social factors relate to how human-like the agent is viewed as being by the user (how “believable” the agent seems).

### **Narrative and Believable Agents**

One approach to the design of agents in order to generate believable behaviour is from the perspective of character.

Perlin and Goldbers’ (1998) rationale for this believableness stems from the desire to convey mood and personality in order to express emotional messages or to portray specific characters rather than to solve a particular problem. They note that in certain applications the *way* in which the agent provides information can be as important as the information itself.

In terms of a contextual model, the insight here is that human social cues apply to these agent-based systems, and they provide a great deal of contextual information to the user. The findings of Reeves and Naas (1996) concerning the inability of people to distinguish between media and real-life can also be understood from the perspective of media providing social context, which affects how the media are perceived. Such social conventions have a major effect on human-human interaction and consequently on human-computer interaction, especially when the computer exhibits some human-like qualities. Reflexively, the goals of affective computing (Picard, 1997) can therefore be viewed as enabling agents to contextualize these social cues from users.

Sengers (1998) examines the transitional behaviour of existing social agents and observes that behavioural changes (between observable states of behaviour) exhibit patterns that are similar to that of schizophrenics. The change between observable actions lacks coherency, and this manifests itself in a parallel fashion to a human mental disorder. Sengers poses the question “how can an agent [behaviour] appear coherent to the user” and answers “by supporting the user in constructing coherent interpretations of the agent”. This is the same as enabling the user to contextualize the behaviour of the agent. Because the user uses the agents’ actions and behaviour to interpret the agents’ activity, the cues that the agent provides form the context in which the user places the whole interaction. By allowing the agent to provide appropriate behavioural cues for the user, the agent is *contextualizing* for the user, and this in turn facilitates the *user’s* contextualization.

### **Contextualization and Narrative**

The other issues that concern the designers of believable agents also benefit from a re-analysis from the perspective of context and contextualization. The improvisational qualities sought by researchers such as Hayes-Roth and van Gent (1997) become the ability to make use of context in a way that *situates agent behaviour within a context*. This is the central tenant of improvisational theatre, the difficulty being the dynamics of improvisation and the ability to contextualize as the context changes. Other forms of storytelling use the term *narrative* to describe structure. The arguments about the use of narrative by agents (and in interfaces generally) pivot about leveraging the user’s inherent knowledge about how these structures provide context and understanding. A narrative provides a framework for an audience to construct a context that

constrains their expectations of how a medium will behave. In this way, narrative can be viewed as a conceptual framework for providing an interactor with contextual constraints.

Narrative (in a structuralist sense) is seen as the communication of a linked set of events (Rimmon-Kenan, 1983). This linking allows both structural and temporal links to be made within a story, and this in turn allows contextualization to take place in the audience (e.g. Mateas, 1997). The basis of Narrative Psychology (Bruner, 1986; 1990) is that *intentional* understanding is obtained by structuring events into stories (the alternative view being that *inanimate* understanding - the computer as tool paradigm - is understood by cause and effect and logical reasoning). The rationale for understanding intentional behaviour in this way means that systems should incorporate narrative to provide an active, socially constructable context (contextualization).

### Narrative as Contextual Constraint

Narrative and contextualization share many of the same attributes. They are both active processes, and they are may be viewed as being composed of several different elements. Narrative can be decomposed into the structural elements shown in figure 1. (Chatman, 1978 cited in Galyean, 1995).

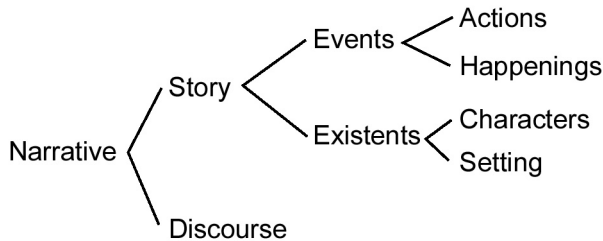


Figure 1. Elements of Narrative.

Narrative is seen as being composed of a representation (Story) and the presentation of the story (Discourse). The discourse essentially becomes the rendering of the story onto some form of media. The Story, in turn, is divided into Events and Existents. Each of these elements can then be examined in terms of the contextualization it can provide. For example, character is viewed as an important element of storytelling, and the relationship with believable agents is obvious, as is the context that can be provided using characters as the embodiment of social cues. In a similar way, “setting the scene” is synonymous with providing context. Events may be compared with the concept of tasks, the sequencing, structure and composition of which provide vital contextual information.

Mateas (1997) links character with story, and defines drama as consisting of characters, story and presentation. A story (narrative) is an experience with a temporal structure and defined presentation. Interaction, as the ability to

influence temporal structure and presentation, raises the question of what is meant by the term “interactive story”? By allowing a communicative dialogue through interaction, the agent must be intelligent enough to guide the story in a way that provides the required narrative as interaction takes place. Oz takes an alternative approach of confining the interaction to certain points in the narrative, and allowing branching to take place. This is an approach taken by many computer games and (semi-) interactive fiction, and constrains the number of paths that the agent must be capable of navigating through. A dynamic approach to interactive narrative essentially provides an intelligent interface that manages the presentation of the story according to some set of criteria. For example in “Dogmatic”, Galyean (1995) presents a virtual environment that changes the events and appearance of the world to prompt a participant to take action that is meaningful to the narrative. Using these narrative devices, a context is provided as an overall story “shape”, but events still change within this framework (and contextualization takes place within these constraints). It is also worth noting that narratives also belong to recognisable genres, and these provide contextual constraints before a narrative begins. It may be that the design of compelling interactive narratives will only be possible when the need to maintain contextualization is appreciated. This will necessitate a different approach to authoring interactive narrative in which contextualization in each possible story-thread is explicitly considered.

### Narrative in Context

Theories of Context and Contextualization can therefore be viewed as encompassing narrative theories from a communicative agent viewpoint. Comparing the elements of context and contextualization with the elements of narrative, an interactive narrative framework may be viewed as implementing many of the required elements for providing the means for an agent to contextualize.

Contextualization	Narrative
The external world (the situated context)	Genre and social elements of narrative
The set of goals and tasks (the focal context)	Story (events) and sequencing
A model of the user (the user context)	(the intended audience)
The form of dialogue (elements of agent role and social context)	Discourse and story existents
Dialogue representation (physical representations of context).	Discourse, presentation style

Table 1. Comparing Contextualization and Narrative

This comparison of interaction paradigms (Table 1) offers two models that can be used simultaneously to inform the design of interaction. Narrative necessarily draws on a

model in which interaction is viewed as a controlled distribution of knowledge, and interaction affects this because time and sequencing are part of the story and the task. From an interactive viewpoint, actions at the interface can be viewed as “histories” - emergent narratives grounded in time - and this can provide structure to the interaction. Note that context makes explicit a model of the audience, an important factor in creating both narrative and interface.

### A Framework for Design

Figure 2 shows a framework which combines models of contextualization and interactive narrative using elements taken from intelligent and adaptive interface design (Meech, 1994). The framework is intended to emphasise that when *designing an interactive narrative*, it is possible to map this process *onto designing an interface to enable contextualization* (and, of course, the converse may also be true). Thus techniques and devices from both fields of study may be used and integrated using this framework.

In this framework, a User Model component encompasses elements of user behaviour and user preferences that influence contextualization. In essence this model represents the salient properties of whoever is interacting with the agent. These factors constrain interactions with the task set (or narrative events) as specific user characteristics will influence the traversal of a task hierarchy based on known user preferences within tasks. For example, at a general level, if the interactor is viewed as passive, events may be generated to prompt the interactor to take action. In this way both the User Model and the Task Set influence the way in which a dialogue is instigated (by user or system) and the role which the agent may adopt. User preferences form the User Model may directly affect dialogue instigation and discourse structure by specifying a preferred dialogue style or agent role, and the selected Task Set may further influence this (e.g. by pruning the tasks and subsequent dialogues). The dialogue model may, in turn, affect the traversal of the task hierarchy based on the form of dialogue style selected.

The form of dialogue and the tasks possible in the domain finally impact the way in which the dialogue is rendered. Preferences combined within dialogue models may select a particular modality (speech, text, graphics, etc.) or may constrain the rendering in a particular modality in order to conform to particular user expectations (e.g. a particular look and feel, dialogue style, etc.). At a character level, this may be used to select or generate different visual appearances, behaviours (and personality) of the agent.

In combination these components interact dynamically to produce an interaction context. The interactions between the components can be viewed as the process of contextualization, as this process of constructing the form of interaction provides a way of managing the cues which allow the user to contextualize the system’s behaviour. By

monitoring the user’s interaction, the system may, in turn, contextualize the response of the user and generate a new context which allows the user to contextualize and respond appropriately. This allows the system to maintain a shared context with the user that disambiguates the interaction.

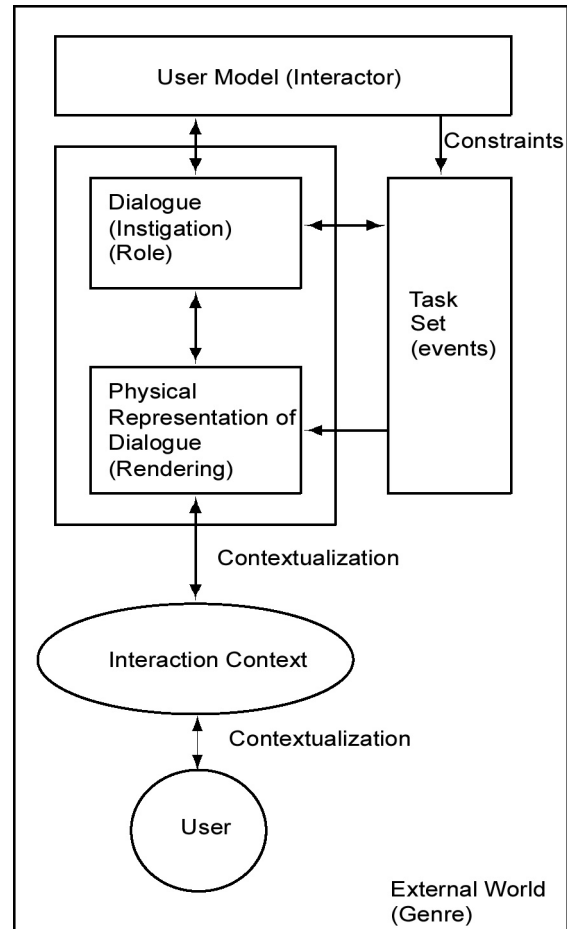


Figure 2: A Framework for Contextualization

Using this framework, appropriate interaction models may be chosen, forms of dialogue instigation and control specified, and rendering of the agent can be designed to be consistent with these choices. For example, the role that the interface plays may be specified and the external domain factors that influence the interaction may be identified, including those particular to the user in relation to the domain.

The advantage of having such a model is that it compels a designer to consider both the process of contextualization, and the components of context which are important in the domain under consideration. In addition, it highlights the importance of exploring contextualization factors which lie on the border of what would normally be considered, and incorporates all of these into a single model of interaction

using either a conventional or agent-based design paradigm.

### Elements of Contextualization

From the preceding analysis it is possible to identify several factors which promote contextualization in agent-user exchanges:

#### 1. The External World: Social Cues

Social cues affect a range of agent behaviour. For example, the level of autonomy shown by an agent is, to varying extents, a factor of social context, as this relates a dominance factor in terms of personality traits. Other social conventions such as the establishment of genres also help place interaction into a more specific context. This and other findings show that the use of social cues can be used to enable the agent to provide better contextualization by the user.

#### 2. The Set of Tasks: Task Models

Tasks structures conceptually provide context to the user and facilitate the mapping of user goals to appropriate outcomes. The user needs to know what tasks are possible in a give context. The more coherent the tasks, the more constrained the context (and vice-versa). The same is true in the sequencing of event in a narrative. Consequently, the agent should utilise task models to provide coherence and the appropriate cues in interacting with the user. Narrative provides one such task model, and consequently should provide better interaction coherency.

#### 3. A Model of the User: User Preferences

The ability of a system to act appropriately in a given context (*adaptation*) requires that the agent have both a model of the tasks, and also knowledge about how the user is likely to behave in carrying out those tasks. The agent should therefore make use of user preferences in order to better contextualize. This parallels a model of intended audience in a narrative model of interaction, and providing narrative guidance can be viewed as implementing an adaptive interface in which presentation varies to maintain the plot.

#### 4. The Representation of Dialogue: Interface Adaptation

The agent should be able to adapt the interface in order to prompt the appropriate contextualization in the user. This will enable the adaptation of the interface for a given usage context. Elements of presentation and dialogue concern both structural elements (who takes the initiative, who is dominant or has control) and elements of presentation (the modality the dialogue takes, and cues within the dialogue itself). For example, implementing dialogue control as embodied by a believable agent has many characteristics which can be viewed as methods of constraining context – what the agent looks like, sounds like, its behaviour, its social relationship with the user, etc. These elements should be designed not only from the viewpoint of character, but also from that of context.

### Conclusions and Future Work

This paper has compared the paradigms of Narrative and Contextualization in interaction design and drawn interesting parallels between the way each model can be applied in the design of interaction. Current and future work is examining how these theories can be applied to the design of interactive agents.

Current research is investigating the use of models of contextualization and narrative in the design of personal communications agents (extensions of the work in Liscano et al., 1999) and in the design of narrative environments (e.g Tallyn and Meech, 1998). The goal of this research is to identify the utility of various agent-interface models as user interfaces to complex systems. This work will investigate the implementation of a range of agent design models to identify effective heuristics for agent design. In the future it is hoped to investigate elements which are known devices in narrative (especially personality and emotion) and investigate their application to the design of interface agents.

### References

- Bickmore, T.W., Cook, L.K., Churchill, E.F., Sullivan, J.W. (1998) Animated Autonomous Personal representatives. *Proceedings of the 2<sup>nd</sup> Int. Conf. On Autonomous Agents*, Minneapolis/St. Paul. MN. USA. May 9-13, 1998.
- Brown, J.S. and Duguid, P. (1994) Borderline Issues: Social and Material Aspects of Design. *Human-Computer Interaction*, Vol. 9 No.1 1994.
- Bruner, J. (1986) *Actual Minds, Possible Worlds*. Harvard University Press, Cambridge, MA.
- Bruner, J. (1990) *Acts of Meaning*. Harvard University Press, Cambridge, MA.
- Chatman, S. (1978) *Story and Discourse: Narrative Structure in Fiction and Film*. Cornell University Press.
- Cooper, G. (1991) Context and its Representation. *Interacting with Computers*, Vol.3, No.3, 243-252
- Croft, W.B. (1984) The role of context and adaptation in user interfaces. *Int. J. Man-Machine Studies*. Vol. 21, pp283-292
- Edmondson, W. H. and Meech J. F. (1994) Putting Task Analysis into Context. *SIGCHI Bulletin* Vol. 26 No. 4, October 1994. ACM Press.
- Galyean, T.A. (1995) *Narrative Guidance of Interactivity*. (PhD Thesis), MIT Media Lab. Boston. MA.
- Hayes-Roth, B. and van Gent, R. (1997) Story-Making with Improvisational Puppets. *IJCAI'97 Workshop on Animated Interface Agents: Making them Intelligent*. Nagoya, Japan. August 25, 1997

Liscano, R. Meech, J.F. Impey, R. (1999) Configuring a Personal Communications Agent. *Proceedings of The Practical Application of Intelligent Agents and Multi-Agent Technology Conference IV (PAAM'99)* Monday April 19 - Wednesday April 21, 1999, London, UK

Mase, K. (1997) Aspects of Interface Agents: Avatar, Assistant, Actor. *IJCAI'97 Workshop on Animated Interface Agents: Making them Intelligent*. Nagoya, Japan. August 25, 1997

Mateas, M. (1997) *An Oz-Centric Review of Interactive Drama in Believable Agents*. Carnegie Mellon University Report CMU-CS-97-156. Pittsburgh, PA. USA.

Meech, J. F. (1994) The Intelligent Management of Information for Human Interaction with Complex, Real-Time Systems. *AAAI Spring Symposium on Intelligent Multi-Media, Multi-Modal Systems*, Stanford University, USA March 21-23, 1994.

Mittal, V.O. and Paris, C.L. (1993) Context: identifying its elements from the Communication point of view. *Proceedings of the IJCAI-93 workshop on Using Knowledge in its Context*. August 29, 1993. Chambéry, France.

Perlin, K., and Goldberg, A. (1998) *Improvisational Animation*. White-paper available at the New York University Media Research Lab, New York, NY. USA. <http://www.mrl.nyu.edu/improv/whitepaper/index.html>

Picard, R. (1997) *Affective Computing*. MIT Press

Reeves, B. and Nass, C. (1996) *The Media Equation*. CSLI Publications. CA. USA.

Rimmon-Kenan, S. (1983) *Narrative Fiction: Contemporary Poetics*. Methuen.

Sengers, P. (1998) *Anti-Boxology: Agent Design in Cultural Context*. (PhD Thesis). Carnegie Mellon University Report CMU-CS-98-151. Pittsburgh, PA. USA.

Tallyn, E and Meech, J.F. (1998) Developing the Interactive First Person P.O.V.:Using Characters as a Sensory Lens. *Proceedings of the ACM Conference on Computer Graphics and Interactive Techniques SIGGRAPH'98*. Orlando, FL. 19-24 July, 1998.

Tyler, S. W. and Treu, S. (1989) An Interface Architecture to Provide Adaptive Task-Specific Context for the User. *Int. J. Man-Machine Studies* Vol.30, pp303-327

Wilson, M. (1997) Metaphor to Personality: the role of animation in intelligent interface agents. *IJCAI'97 Workshop on Animated Interface Agents: Making them Intelligent*. Nagoya, Japan. August 25, 19