

Natural Interfaces for Collaborative Narrative Construction

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Certificate of Original Authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

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Damian Hills, 2017

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Abstract

This thesis addresses research with the design of a system for collaborative narrative construction that supports the process of conversation associated with narrative creativity and coherence. It presents a set of theoretical design features for a system that combines semi-autonomy with an interface that responds to natural user interaction, such as a touch enabled or gestural device. The design aim is that of a holistic software architecture or one that enables active engagement in the emergence of meaningful community narrative, the value of which is centrally based around the notion of narrative coherence. This research presents a set of design features that enable conversation and collaboration that both support the generation of coherent narrative.

In a holistic system design, the embodied action associated with conversation in verbal and nonverbal form is central to narrative exchange, and the process by which further knowledge is extended by communal agreement. These are systems that extend knowledge where the role of the participant is integral to the systems feedback and maintenance of its own self-organised behaviour. With the software architecture, *assimilate*, participants engage a multi-user space with a reactive interface that overlays a visual collaborative media environment. It consists of three tiers that are constructed in a networked architecture, including a template database with a priori knowledge, a self-organising application that merges concepts, and a physically responsive interface that supports collaboration and group conversation. The specific interface component provides expressive affordances that enhance narrative comprehension in the minds of the participants, allowing them to dynamically switch roles as narrator or participant. Common gestures associated with narrative construction are mapped to interface mechanics, such as *scope*, *merge* and these reflect participant intention, forming a narrative *point-of-view*. Embedding these metaphors into the interface design appeals to these narrative actions, thus supporting the recognition of meaning or intention.

The system design is supported by a knowledge generation application consisting of a self-organising network of concepts that are designed to directly reflect the collaborative mechanics of the interface layer. The basis of this model is inspired by Conversation Theory (CT) (Pask 1976), a 2nd-order cybernetic theory of learning and social interaction, that demonstrates how to maintain narrative coherence while taking into account the collective viewpoint and interpretation of collaborators. It places group conversation as central to its process and outlines a formal method of conversation as a negotiation of shared agreement, with the formalisms adapted for the system design into a conceptual level (*Storyworld*) and the procedural level (*Storyline*). The CT model allows for a cyclic interpretation and may be suitable to a range of narrative styles in a domain independent and scalable way.

From a series of evaluations with a practice based methodology, the findings demonstrate how each feature contributes to an increase in collaborative narrative coherence when combined in the proposed system. Three specific features have been identified. Firstly a series of interface schemas for narrative comprehension that are modelled within the physical properties of the interface. The findings suggest metaphorical schemes develop support for collaborative conversation through assisting with nonverbal conversation, providing a metaphorical boundaries, and showing how concepts may *merge* with the possibility of generating novelty. The second feature highlights the system as a collaborative tool and how it develops group conversation allowing dynamically shifting roles as *narrator, player or observer*. Group experiences directed the narrative into new directions providing emergent outcomes that contributed to coherence. Finally, the self-organising application modelled on CT principles presents a two-layered approach of *Storyworld* and *Storyline*. This was found to develop *agreement*, a CT principle by which a group understanding takes place. With a constrained corpus of templates and a strong familiarity with a *Storyworld*, the system developed clear boundaries of narrative context that contributed to group coherence.

In conjunction with natural user interaction, the combination of these features within the software architecture was found to support collaboration and this led to an increase in narrative coherence. These findings further understanding of how collaborative system design and natural user interaction combine for generating narrative emergence. This contribution is highly relevant for designers that aim for *holistic* collaborative system design and the possibilities that natural user interaction brings to new forms of collaborative knowledge generation and creativity.

1. Introduction

1.1 Introduction

This thesis addresses research into the design of a system for collaborative narrative construction that supports the process of conversation associated with narrative creativity and coherence. It presents a set of theoretical design features for a system that combines semi-autonomy with an interface that responds to natural user interaction, such as a touch enabled or gestural device. The design aim is that of a *holistic* software architecture or one that enables active engagement in the emergence of meaningful community narrative.

With the software architecture, *assimilate* (Hills et al. 2008), participants engage a multi-user digital space with a reactive interface that overlays a visual collaborative environment. It consists of three tiers that are constructed in a networked architecture. They are a database containing a set of templates with a priori knowledge, a self-organising application that merges results with selected templates, and a physically responsive interface that supports collaboration and group conversation.

This design contains a set of key design features that enable and support conversation, collaboration and narrative development. In a holistic system design, the embodied action associated with conversation in verbal and nonverbal form is central to narrative exchange, and the process by which further knowledge is extended by communal agreement. The assumption is that the enactment of narrative, or the act of the telling through conversation, is the means by which mental models of stories are formed, shared and extended. These are systems that amplify or extend knowledge based on their historical relationship to the environment where the role of the participant is integral to the systems feedback and maintenance of its own self-organised behaviour.

Within the context of the development of this design and a set of appropriate features that support collaboration and conversation, the following research question will be addressed:

What aspects of design best support narrative coherence with collaborative semi-autonomous systems, in particular, how can natural user interfaces assist with narrative sense-making?

The remainder of this chapter will discuss the importance of this question, and how the development of the *assimilate* system and aspects of its design can support collaboration and coherence generation.

1.2 Context and Significance

In recent years there has been significant research interest in developing interactive digital systems that produce coherent and emergent narrative based on participant choice. Yet a foundational issue with all systems that propose such designs are bound by the limitation of narrative freedom versus participant agency. When system designers allow the participant freedom to make choices that effect narrative outcome, they also risk developing meaningless or unintended outcomes. This in turn breaks the engagement and agency of the experience.

There are numerous methods to circumvent this issue, for example, giving the participant more choice surrounding a minimal set of narrative plot points, although this limits the possibilities for interesting outcomes, or placing limits of the interaction and offering an illusion of narrative. This has been a topic of research for many in diverse fields of design and computer science, with projects looking to solve a particular part of the issue, many of which are reviewed in this thesis.

The research presented here is no exception, however it offers a differing view. While not solving the general issue of narrative coherence and system interaction, if such a problem can truly be resolved, it attempts to understand the nature of storytelling as it occurs in human interaction and suggest a design that supports this conversational process. In group conversation, experienced storytellers seemingly bring together a range of situated factors with flexibility and timing. Instinctively they know how to engage their audience with empathy, while understanding differing views and narrative delivery. For system designers looking to support this conversation they need to place a focus on face-to-face group situations and emphasis how mental models and intentions are understood by others, and not necessarily by the system itself.

This is a system that supports situated action, where the enactment of narrative by participants is mediated by the conversational knowledge generated by the system. Such systems look to holistic paradigms of information retrieval and exchange that utilise embodied action to deliver coherent experiences. A system design that incorporates elements of our own embodied forms of conversational exchange and innate methods of story delivery can also springboard and support the intentional aspects of its participants. The dynamics of participant intentionality with the system's architecture is open to interpretation from the common metaphors found within the systems motifs, relying to some degree the canonical recognition of universal narratives.

For a holistic system, the active participant formulates knowledge on the basis of engagement. In the *assimilate* project (Fig. 1), the embodied action associated with conversation in verbal and nonverbal form is central to narrative exchange, and the process by which further knowledge is extended by communal agreement. The assumption is that the enactment of narrative, or the act of the telling through conversation, is the means by which mental models are formed and shared. Essentially, any knowledge structure is a result of metaphorical associations from existing conceptual domains and are said to

originate from our affective experiences. This explicates the origins of narrative as an inductive process drawn directly from events and outcomes from our experiential life.



Fig. 1 *assimilate* project.

If our stories originate with our embodied actions, a holistic design must take into account how we *assimilate* narrative into our common experiences, not only through the recognition of canonical themes but also through our primal actions. Systems that support primal embodied metaphors can assist participant recognition of the acts and intentions of others with respect to the feedback generated. Embedding these metaphors into the interface design can appeal to these embodied actions, thus supporting the recognition of meaning or intention. This is done primarily through situated actions, where gestural acts drive the experience and support the conversational aspects associated with storytelling. Each gesture triggers physically modelled feedback that supports the intention behind the act, and may promote a conversation or a verbal response to clarify the action.

The general approach to the interface and its incorporation into the narrative system architecture is through expressive affordances that enhance narrative comprehension in the minds of the participants, allowing them to dynamically switch roles as narrator or participant. Common gestures associated with narrative construction are mapped to interface mechanics and help to reflect participant intention such as scope, conceptual exchange and forming a 'point-of-view'. It is shown that these mechanics in conjunction with the system feedback can enhance or extend narrative coherence and assist participant recognition of the acts and intentions of others with respect to the feedback generated. Embedding these metaphors into the interface design can appeal to these narrative actions, thus supporting the recognition of meaning or intention. Metaphor in this case binds the meaning making in the minds of the participants through visibility of those verbal and nonverbal actions, and the visible output of the interface and becomes more accessible for collaboration (Fig. 2).



Fig. 2 *assimilate* interface.

While the interface is an essential component of the system, the architecture also consists of two further tiers that attempt to model the system's processes to assist the collaboration and mediation of the interface and its participants. The first tier, is a non-hierarchical database consisting of a set of template knowledge. A narrative template is considered a simple conceptual representation in a system database that can be extended or further modified and used as a basis to generate new sequences that form relevance to a particular group, community, or artistic domain. Psychologists (Bruner 1990) suggest the narratives we tell accrue into larger meta-narratives, developing cultural identities for a particular community that habitually tell certain stories. These narratives are said to be canonical, and easily recognisable to those with similar contexts be it cultural or situated circumstances. This gives direction on how narrative system design can use canonical concepts (or narrative templates) to seed the creativity of a community of participants, and allow those extended narratives to further accrue, shaping a collective meaning.

The second tier, consists of a self-organising network of concepts that is derived from template knowledge and directly reflects the collaborative interface mechanics of the interface layer. The application tier, attempts to organise the content and manages the boundary of the *Storyworld* and the procedural aspects of the *Storyline*. Specifically, the basis of this model is inspired by Pask's Conversation Theory (CT) (Pask 1976), a 2nd-order cybernetic theory of learning and social interaction, that can demonstrate how to maintain narrative coherence within a set of assembled themes, while taking into account the collective viewpoint and interpretation of collaborators. This places group conversation central to its process and outlines a formal method of conversation as a sense-making network or a

negotiation of shared agreement given differing perspectives surrounding several interrelated themes, that lead to eventual action or procedures that clarify the context. Pask defined conversation based on two distinct levels, description of knowing ‘why’ (cognitive or conceptual) and knowing ‘how’ (procedural or performative). This cognitive distinction is useful in identifying the learning styles of participants that are classed as either ‘serialist’, understanding topic relationships through steps, or ‘holist’, taking a global approach. Both styles can be incorporated into the same network, as typically most learners used some combination of both. From a storytelling standpoint, this allows a focus with which to take a particular narrative perspective and compare that to the other collaborators, globally or locally within a story world. The basis of the formalisms found in CT are adapted for the system design, with the conceptual level developed as the *Storyworld* and the procedural level as the *Storyline*.

Modelling the thematic relationships in a conversational form, with Pask’s model, allows for a cyclic interpretation and may be suitable to a range of narrative styles in a domain independent and scalable way. CT entailment structures can connect concepts using common sense and rhetorical relationships that extend the meaning beyond the literal boundaries creating a link with our cultural narratives that the system itself cannot capture. This holistic aim of negotiating agreement and sense-making was largely the motivation of Pask’s CT and there significant applicability of his research to collaborative narrative research.

1.3 Method

This research seeks to demonstrate an original contribution to knowledge in the area of narrative and storytelling systems by the development and evaluation of a novel artefact. Given this aim, a practice based research methodology is adopted. This broad method allows for a qualitative interpretation on the creative outcomes of the artefact and an evaluation of the participant’s subjective experience during the engagement of the work.

Evaluating the user experience of narrative systems remains a difficult process for research. An effective evaluation of user engagement should emphasise a coherent recognition of narrative experience as well as any aesthetic understanding. In addition, since the experience relies on collaborative effort, evaluation of a meaningful experience should be considered as much collective aesthetic as an individual one.

The criteria is centrally based around the notion of coherence. A meaningful narrative is considered coherent if the contained concepts and metaphors are made meaningful to the participants in the shared experience. In other words, if those metaphors fit to the belief shared by those in the experience. This stems from a theoretical concern that each community discovers knowledge from their own construction rather than from a central idea of truth. Essentially, for any knowledge, be it conceptual, metaphorical that is realised individually or collective, it can only be understood, evaluated and ultimately reflected upon during the time that the associated modalities with the experience were unified. This means to qualify the knowledge, not only after it was recorded subsequently in a database for example, but to

understand the associated experience at the time of the exchange. This is an attempt to illuminate how the participants reflect upon the experience and the actions they took in combination with the system's feedback, as well as the actions of the other participants.

This particular method extends the process of video cued recall (VCR) analysis that has shown to be fruitful in identifying key moments (Costello et al. 2005, Bilda et al. 2007) of engagement especially in relationship to understanding the role that participant embodiment plays with interactive works. VCR analysis can highlight interesting collaborative sessions during the time of the installation. In the case of the work in question, the narratives generated during each session are not statically developed, rather they are largely dependent on situation and context.

The evaluation should therefore depend upon the following criteria:

- participants recognition of a coherent narrative or story
- participants willingness to collaborate and contribute to a group experience
- participants reflection upon the subjective and aesthetic experience of the work.

This evaluation is based on an iterative process of data collection followed by further refinement and development. Data collection methods include informal interviews, data logging and observation. A practice based research methodology and other methods of reflection (Schön 1983), aims to draw out relevant knowledge and illuminate the aspects of the design that support the collaboration.

1.4 Contribution

This research will demonstrate an original contribution to knowledge in the area of natural user interaction and collaborative narrative systems through the iterative development and evaluation of the software architecture *assimilate*. This system incorporates a set of design features that support narrative construction in collaborative contexts. From a series of evaluations with qualitative studies, each feature is shown to contribute to an increase in collaborative narrative coherence when combined in the proposed system.

These include:

- Interface Schemas For Narrative Comprehension
- Developing Collaboration
- Conversational System Design

Furthermore it will show how natural user interfaces complement these features and support systems that aim for creative outcomes in more varied and interesting ways.

1.5 Outline

This thesis presents a literature review in Chapter 2, containing a wide range of topics on narrative theory, narrative system design, narrative emergence, cybernetics, epistemology and play theory. For Chapter 3, a methodology based on a qualitative framework of mixed methods featuring video cue recall. In Chapter 4, a presentation on a holistic system of narrative construction, *assimilate* including designs, models, iterations and theory. In Chapter 5, a results of 7 evaluation studies with a report of outcomes, and finally in Chapter 6, a conclusion and implications of the research.

2. State of the Art

This chapter will encompass the range of relevant literature to the thesis topic and the theoretical basis of the system design. This commences with various topics relevant to narrative creativity, including a position on human cognition and its ability to be creative (2.1), followed by an understanding of narrative psychology, our narrative intelligence and its applicability to system design (2.2). The chapter then diversifies into relevant theories within second order cybernetics (2.3), artificial intelligence, robotics and relevant artistic forms of expression within these fields (2.4). The chapter then explores the field of interactive digital storytelling systems with a literature review of relevant works within this field (2.5). Finally, the chapter ends with a theoretical basis for how emergent play can be developed within semi-autonomous systems and games (2.6).

2.1 Creativity and Cognition

This section examines the theoretical basis for how our cognition has developed the ability to develop narrative creativity and its applicability to system design. To understand this, we must look to the development of early hominids and the mimetic skills that refined bodily movements. These skills allowed us to develop speech, the invention of symbols, and the eventual creation of storytelling. This mythic culture (Donald 1993) is the second of three great stages in the development of cognition that formed the basis of how creativity is produced in modern man. The final stage was accelerated from the externalisation and sharing of knowledge and continues further still as we develop new forms of knowledge sharing that modern computing brings. The important aspect of this particular theory of cognition is the relationship to culture, and especially how our body relates to culture. For the body is situated in the world of culture and is integral to its interpretation and communication to others. This socio-cultural approach states development of cognition developed externally or ‘in the wild’ (Hutchins 1995) from engagement with the world outside the body. While not denying the mechanism of internal states, it is wholly reliant on all outside groups, artefacts and modes of communication of the external world. Within cognitive science this is known as the theory of ‘enactivism’ (Varela et al. 1991) that states this historical relationship of the body to its environment evolved our modes of thinking, planning and reacting. Ecological systems display evidence of this complex relationship in a form of ‘structured coupling’ (Varela et al. 1974), or autopoiesis. Systems are viewed as being ‘operationally closed’ or self-regulated, for this reason they can be viewed as an emergent form of self (Thompson 2007) that is open to sense-making. Although there may be suitable arguments made about the differences of sense-making as cognition or adaptation (Boden 2000), Thompson’s view places sense-making and adaptation as a fundamental to cognitive development.

Although autopoiesis applies to living systems, the influence of the model stems in part from cybernetic theories, specifically second order cybernetic theories (Foerster 1981, Scott 2004) that were developed as a subset of a general systems theory (Von Bertalanffy 1950). Second order cybernetics has been applied to a

number of fields including ecology (Bateson 1972), sociological processes (Luhmann 1995) and cybernetic models of learning (Buchinger 2010). This version of cybernetics adopted an epistemology known as radical constructivism (Glaserfeld 1995) in which the viability of knowledge is evaluated by corroboration and intersubjectivity. This epistemology is considered 'radical' as it takes a particular view within constructivist theories where our concept of reality is neither rejected nor confirmed, as in agnostic not solipsistic as it is commonly accused. Reality in this theory 'fits' with our perception based on our historical experience within the world. It is based on the notion of coherence that the cognitive mind while 'closed' in terms of its own operations, is 'coupled' and shaped based on feedback. This position on epistemology is important within human computer interaction as it is applicable to the design of systems utilising semi-autonomy. Collaboration with semi-autonomous machines develop a shared meaning that is primarily made by the human interactors while the system itself offers metaphors applicable to wide range of contexts but no absolute truths. In other words, the system understanding the participants definitive meaning is not a necessity and would only work against developing creative analogies. Understanding the connection between the living organism (participant) and these social processes can provide clues on appropriate ways to formalize knowledge representation in artificial systems and provide appropriate feedback mechanisms to allow a natural form of engagement.

The question is, what form do these feedback mechanisms take? Again, clues from human ecology and more specifically our embodiment in the world can provide appropriate answers. Assuming our cognition is dependent on environment, it stands to reason that all acquisition of knowledge, including those of primal embodied action must have originated from our lived experience. This explicates the origins of knowledge as an inductive process drawn directly from events and outcomes from our experiential life. Knowledge, as Vico suggests, is viewed as layers of constructed metaphors that are shaped from our existing conceptual structures (Danesi 1995). Any knowledge structure is a result of metaphorical associations from existing conceptual domains that are said to originate from our affective experiences.

Constructed metaphors are viewed as, not only the method by which language is developed (Lakoff & Johnson 2008a), but also embedded within the primal forms of our bodily actions (Johnson 2013). Johnson calls these primal metaphors "image schemata", that correlate particular forms of embodied experience, such as a conversational gesture, with their appropriate action in the world. As such, these primal embodied metaphors carry a depth of meaning that make them instantly recognisable and vital in communication. As a source of potent feedback to the living organism, they can be useful in design of artificial systems open to supporting these metaphors, with particular schemes, for example *scale*, *merge* and *contain*.

Theories of metaphor with respect to mind and its bodily relationship with the world are also developed by Modell (2003) where the brain's limbic system is shown to have adapted through its emotional capacity. Through metaphor, our cognition has shaped and interpreted our feelings. With any neuro-physiological view of creativity, it is clear the limbic system must be included as a vital part of the model (Takala 1993). In this sense, emotion and our capacity for creative imagination are intertwined and essential to rationalising the world (Damasio 2000). Furthermore, by combining the bodily relationship

to the world including action, feeling and the metaphorical interpretation thereof we are given a set of constraints to operate.

These constraints while seemingly representative of a large almost infinite world are in fact defined by our historical relationship to them. This view suggests a finite space where exploration of the possibilities can generate a creative jump or a transformation (Boden 2003). This transformation Boden names as 'impossibilist', akin to a modification of a wall in a conceptual maze or a breaking of a formal rule within a set of conceptual rules. Koestler also sees this as a 'bisociation of matrices' (Koestler 1964) where conceptual spaces are fused together after tedious exploration of the possibilities. However Boden sees Koestler's view, while on the right track, as somewhat vague and seeks to illuminate exactly how such novelty arises. Boden's concern lies specifically with how creativity works and its possible application to machine generated creativity. Most artificial intelligence models of creativity develop a space for the combination of various conceptual arrangements. Boden critiques these models for lack of reflection over their own combinations, in that no appropriate self-evaluation of novelty or flexibility is apparent. Although Hofstadter's CopyCat (Hofstadter & Mitchell 1994) is given credence on the basis of its ability to adapt analogies during runtime, the basis of this model and others such as Minsky's 'frames' (Minsky 1974) stem from psychological theories of how knowledge is organised into schema (Bartlett & Bartlett 1995). Similar cognitive models include the notion of conceptual blending (Fauconnier & Turner 2008) that led to other AI models such as (Pereira 2007) or (Veale 2012). While this focus lies in understanding creativity in autonomous systems, it is also applicable to semi-automation and how co-creativity arises through both human and computer collaboration. While a formal system of systematic rules may be necessary to discover novelty, designers of semi-autonomous systems also view creativity as embedded within the human social-cultural world. Through action and group conversation and a formal system of generative capacity, such as a generative language (Chomsky 2014), the human form of creativity arises. This phenomenon has been discussed in various fields where discovery is made with sufficient domain expertise, in communities (Lave & Wenger 1998), tacit knowledge or 'hunches' (Nonaka et al. 1996) and with deep concentration or enjoyment of the experience (Csikszentmihalyi 1991). The important point is that both a formal system and group of individuals are both important for the creative leap to be made (Glăveanu et al. 2014, Sawyer 2011). Thus both computational and sociocultural views of creativity while not fully compatible are both highly relevant for any computational system concerned with human/computer collaborative support for creativity.

2.2 Narrative Construction of Reality

2.2.1 Narrative Psychology

Narrative psychology is the study of how humans develop an understanding of each other and their world through the use of storytelling. This area of research, pioneered by J.S Bruner, places narrative at the centre of human learning and development. In '*Acts of Meaning*' (Bruner 1991a) he develops the notion that culture shapes our meaning and understanding of mind, while biology is simply a set of constraints

that is loosened or extended by these processes. He concludes, our intentional states are organised by narrative into a '*folk psychology*', an accrued set of canonical meanings that are extended or breached by storytelling. This implies that understanding a coherent narrative is largely dependent on our historical background or cultural traditions, yet this cultural familiarity is often transformed by the unexpected event or outcome. This, claims Bruner, is a communal process, where community and a sense of belonging to a shared social environment, aids the balance between the canonical and unexpected deviations. An understanding of community and associated intersubjectivity can point to methods of representing knowledge that manifests thematic sense-making and narrative coherence.

The recognition of the canonical provides a design methodology for collaborative narrative systems by aligning familiar narrative themes or templates with the mental models that participants develop through cultural practices. However, cultural familiarity is often transformed by the unexpected event or outcome. This distinction of the narration as a separate process to story, being 'a series of events' is another key feature of narrative. By citing the Russian Formalists, Bruner (Bruner 1986) places emphasis on the nature of human intention in narrative, namely the timing and mode of its telling (*sjuzet*) over its temporal plot segments (*fabula*). This well known distinction plays a large part in development of interactive storytelling systems (Szilas 2007) and theories (Montfort 2007). These developments look to the difficult task of adapting narration to maintain story coherence. However, for collaborative systems, there may be advantages to narration that is participant enabled or distributed (Walker 2005). A system that facilitates knowledge in this way, would mediate the processes through the typical way communities exchange narrative knowledge, and that is through embodied conversation.

2.2.2 Narrative Intelligence

Asking how we assimilate narrative into our common experiences and form an understanding of each other and our experiential world is to understand something of our inherent narrative psychology. Artificial intelligence researchers (Sengers & Mateas 2002, Blair & Meyer 1997) developed the notion of 'narrative intelligence' as a theoretical basis to understand how this can be applied in the design of interactive narrative and storytelling systems. This develops ideas from Bruner's '*The Narrative Construction of Reality*' (Bruner 1991b) by proposing a set of common narrative features focussing on the hermeneutic properties of narrative. This refers to the idea that narrative comprehension is shaped by its constituent parts, yet complete understanding only comes from a holistic view.

This interpretation of meaning comes directly from the narrative but cannot be empirically identified. Implying, narrative coherence is the formulation from knowledge patterns in our memories rather than a set of atomic rules open to arbitrary selection. In other words, coherent narrative comes from the cognitive models we form to connect the relationships of the events. Stories are said to contain a rhetorical function that reconstructs the past in new forms build upon a set of cultural themes. This recalling of history is dialogical, meaning past events are altered by present events, yet the past also reciprocates this meaning and in turn alters the present. Bruner cites the Levi-Strauss moral stance, in that this function, or mytheme (Lévi-Strauss 1955) is encoded in culture as a method to ensure obligations and

commitments are honoured by successive generations. Later theories on new media took this encoded function to be more like a database (Manovich 1999) that is reconstructed in a narrative form. This ongoing symbol reconstruction is pervasive in culture as some suggest (Cassirer 1946), with familiarity of symbols allowing for complex reinterpretation of stories. This includes aspects of make-believe in children's play where improvisation is given a set of constraints or rules guided by familiarity of a 'storyworld' with cultural boundaries (Ryan 2009). This observation has also been made in theories of play with a 'magic circle' (Huizinga 1949, Salen & Zimmerman 2004), or an agreed space either cultural or physically that set a boundary within a collaborative game.

These theories suggest that cultural norms are pervasive in our culture and dictate how collective meaning is developed from our lived experience. Designers of interactive narrative can benefit from incorporating these observations into their systems and point to a more flexible and creative set of design outcomes.

2.2.3 Narrative Intelligence For System Design

These assumptions provide design clues for collaborative narrative systems, by perhaps allowing an individual to suggest or identify new narrative ideas within a shared social environment that contains typical narrative themes. This individual could then be attributed to instituting a form of storytelling or narration. Interactive storytelling assumes some form of participant control of the system and this creates a direct conflict with coherent delivery of narrative, therefore management of this relationship remains an important factor in any design. To create coherent narrative, interactive storytelling research tends to focus on techniques of plot segment delivery including systems that are rule based (Crawford 2004), goal based (Marc Cavazza et al. 2002) or through narrative functions constrained by a story context (Mateas & Stern 2002). These methods have shown some promise yet they tend to remain tightly coupled to their content thus lacking adaptability to larger or generic domains.

Semantic inference models however, offer the scalability and flexibility needed for systems to encompass larger domains and may ultimately suit collaborative environments. Typically, the basis of the semantic model is a network of interrelated plot segments or events. The semantic network acts as a story ontology that forms meaning from its relations rather than just from the events alone. Interactive storytelling researchers (Tarau & Figa 2004, Tuffield et al. 2006) exploit this fact by using ontology to act as a template that may be permuted into new stories by participants in the narrative. Such templates are desirable by offering an ontology of contextual relationships that can assist in the assembly of a story world. The representation of context in the story ontology allows for a multi-representation (Mueller 2003) of thematic ideas, and is applicable to the representation of a general storytelling corpus. Systems that use common sense reasoning create the basis of the ontological world in which the narrative can take place, and allow the themes to emerge. Looking to Bruner's hermeneutics, it suggests that stories are arguably understood as rich systems of event relations rather than just the events themselves. Here semantic relations can connect the various contextual meanings and form the larger pattern of relational knowledge for mental models to form.

Other researchers (Nakasone & Ishizuka 2007) point to the flexibility of rhetorical relations to connect narrative events. This allows not only the semantic relation of the text, but also the broader sense of ideas and concepts related to the text. Rhetorical strategies like these appeal directly to our mental models of narrative by reflecting points of view during active engagement with the systems processes. As Bogost's (Bogost 2007) notion of procedural rhetoric suggests, the processes reflect a point of view that sits in-between the participant's subjectivity and the rules that make up the system. In a collaborative context rhetorical relations could foster agreement by aligning participants views of the story event relationships and allowing them to cycle through the processes to understand the point of view of the current narrator. This model of storytelling adapts the Rhetorical Structure Theory (RST) (Mann & Thompson 1987) to create the flexibility for an generic models of storytelling to exist, and could influence the design of how such a model could be adapted to collaborative storytelling designs. Essentially rhetorical relations allow for temporal connections to exist, and may serve collaborative storytelling by presenting procedural ways to implement cyclic narrative or *cyclicity*. The benefits of this feature to collaborative models are explained in the following section, under Conversation Theory (1975).

Narrative psychology offers a set of general theoretical features from which to investigate how narrative coherence can emerge from systems in collaborative environments. The literature provides design criteria for a system that makes use of narration in distributed environments. This system would be flexible to incorporate a large domain of existing ontology templates containing sets of semantic and rhetorical relationships.

2.3 Cybernetics

2.3.1 Conversation Theory

In '*Conversation, cognition and learning : a cybernetic theory and methodology*' (Pask 1975), Gordon Pask set out to develop a general theory of human communication and social interaction he named, Conversation Theory (CT). This theory is largely developed as a theory of learning that places conversation as central to its process and outlines a formal method of conversation.

Conversation is defined as a sense-making process or a negotiation of shared agreement given differing perspectives surrounding several topics. The framework developed for CT is essentially a self-organising system where sets of topics may be arranged coherently or whole leading to eventual action or procedures that clarify the context.

Pask (1975) defined his conversation principles based on two distinct levels, description of knowing 'why' (cognitive or conceptual) and knowing 'how' (procedural or performative). This distinction

underlies the process of understanding a topic by looking at its relationship to other topics (why) and the set of procedures to construct or maintain it (how).

CT embodies these two levels into the construction of networked structures known as entailment nets. These are concept networks that embed interrelated knowledge, such that each concept that can be explained or understood by its relationship to at least two others. Such networks are said to introduce *cyclicity* and achieve a conceptual coherence (Pask 1976).

With the creation of a coherent cyclic entailment mesh it is possible to step through and navigate the mesh of concepts for any procedural or sequential operations. Cycling in this manner provides a rich set of possible narrative structures within the entailment structure. Scott (Scott 2000) shows how expository narrative can be applied to CT yet does not rule out that various forms of narrative genre may also be applied:

‘What is needed, and what is provided in Pask’s sub-theory of conversational domains, is a canonical way of modelling the structure of knowledge content such that all possible narrative structures may be revealed and articulated as particular forms.’ (pp. 13)

Murray (1997) defined procedurality as one of four fundamental properties of the digital computing medium, the others being spatial, participatory and encyclopedic. In many ways CT is able to embody all these properties, with the latter three as representations of our conceptual knowledge, and procedurality exhibiting the rules in parallel. In this sense, CT offers a model to combine conceptual and procedural knowledge in a collectively constructed system that is flexible and domain independent. For this reason, it may serve as a model for collaborative narrative and storytelling.

Pask himself was keen dramatist and eluded to the possibility of collaborative storytelling by discussing Koestler’s theory of creativity and innovation (Koestler 1964), from which he draws strong parallels with CT. He states that all of Koestler’s ideas on creativity involve characterisation, and one example might be how an audience of a play might relate themselves to several characters and “thus enact and extrapolate the plot in their own mind.” (Pask 1976, pp. 319). This refers to the fact that the interpretive affordances of the system are of significant influence in the meaning generated by participants and should be a major design consideration for narrative systems. Mateas (M. Mateas 2001) develops this idea in his notion of *Expressive AI* which is discussed further in section 2.4.

CT is a generalised model for representing the structure of conceptual and procedural knowledge. It is this distinction that allows it to create an adaptable framework that is open to collective viewpoint and interpretation, thereby supporting its application to collaborative storytelling systems.

2.4 Understanding ‘Expressive AI’

2.4.1 Introduction

The challenge of artistic practice in the framework of artificial intelligence research is the desire to communicate a cultural context when applying techniques of autonomy. As artists are consciously aware of the need to establish meaningful exchange with the audience, specific tools and techniques are required to create systems of an expressive nature. Expressive AI (M. Mateas 2001) is the intersection of artistic practice and AI research that looks at the production of authored experience for specific cultural concerns. These productions often take the form of behavioural reactive systems that respond to environmental contexts and active participation. The intention is to create artifacts with interpretive affordance (Norman 1999) that are perceived as intelligent for performance purposes and to support the explanation of systemic behaviours. (Mateas 2001) A combination of interpretive affordance and the structure of the machine are necessary to maximise the expressive nature of the artwork. (Mateas 2001) This survey outlines a series of artworks, artists and researchers working with artificial intelligence that demonstrate an understanding of this idea by discussing techniques they apply to achieve expression. Each technique outlined will attempt to show that a combined consideration of interpretive affordance and the behavioural structure of the machine assisted in the depth of expression.

2.4.2 Robotics

In 1986, Rodney Brooks from the MIT Artificial Intelligence Laboratory, took an iconoclastic approach to artificial intelligence that was to influence artists dealing with robotics and autonomy. This technique, he called *subsumption architecture* (Brooks 1995), embodies artificial intelligence in a real world context as a method for researchers to develop intelligent reactions from the environment as opposed to a complete system of cognition. This is constructed as a system of layered behaviour, with each layer consisting of a sensor relating world conditions back to its internal behaviour. Each behaviour reacts accordingly while sharing its reactions with other layers to coordinate the appropriate action. This allows for specific behavioural groups and hierarchies to form by the changing external conditions. The technique of embodiment with layered behavioural hierarchies allows for an expressive system and the potential of affordance as it reacts directly on environmental conditions.

Artists adopted the Brooksian model as a method of creating expressive autonomy with robotics then attempted to develop the behavioural model to suite their aims. Collaborators, Bill Vorn and Louis-Philippe Demers, build theatrical reactive robots that immerse the participant within fantasy worlds. In their work, *La cour des miracles* they present a spectacle of dysfunctional machines seemingly trapped in painful and violent movements. The robots react to sensors triggered by visitors or other robots setting up an affective believable space, "immersed in this simulated world, the audience is more convinced of the simulcra" (Whitelaw 2004). Interpretive affordance is constructed by the believable atmosphere and the affective embodied reactions. The artists present an understanding of expressive AI from the interest in authored experience and the creation of illusionary sentience.

Another artist interested in embodiment and affective intelligence, Simon Penny, develops robots that deal with the emergence of personality. In the project, *Petite Mal*, the artist takes a holistic approach to the design (Whitelaw 2004) that is defined through its combination of hardware and software to create a persona

“...which was nimble and had 'charm' ; that sensed and explored architectural space and that pursued and reacted to people; that gave the impression of intelligence and had behaviour which was neither anthropomorphic nor zoomorphic, but which was unique to its physical and electronic nature.” (Penny 2000)

The robot is fitted with infrared sensors to detect human presence and a proprioceptive sensor to monitor its own body state while the software is designed to give the impression of hyperactivity disorder that switches between levels of consciousness. Attention is given to the limits of external and internal information as the artist maintains that an agent is far more convincing when it elicits an associative response from the participant, adding to the illusion of cognition. (Whitelaw 2004) The limitations allow the audience to derive personality from its reactions. This technique fits within the expressive AI model as it looks to the perceived affordance in combination with its embodiment to emerge its character.

Robotics is one art form of artificial intelligence where the exploration of affective behaviour can communicate specific cultural contexts to the audience. Embodied reactive systems can reveal ways to add authorial control over the experience by placing limitations or using specific interpretive affordance on behaviour to emerge personality and expressive qualities of character.

2.4.3 Interactive Drama

The combination of affective behaviour and authorial intent is also a common technique seen in interactive drama and storytelling systems. The art is concerned with the portrayal of character personality and motivation such that believability is the key factor that gives the perception of real intelligence. *The Oz Project* (Loyall 1997) is a system for the development of interactive drama which defines a character behavioural framework that attempts to maintain a flexible dramatic narrative. A language to script character behaviour, known as *Hap* (Loyall 1997) was developed as a tool for building hierarchy of executed actions that are triggered by preconditions. The success and failure of behaviours are based on world conditions, the behaviour of other characters and the interaction of the player to facilitate a continuous renegotiation of action. *Hap* and other behavioural languages explore ways of expression through idiomatic language (Mateas 2002) that when properly constructed, allows for character reactivity and player input while maintaining the flow of dramaturgy.

Michael Mateas and Andrew Stern later extended this system for the *Facade* project (Michael Mateas & Stern 2003). The concept of drama management is added as a separate behavioural system in an effort to

maintain tighter control of the narrative while allowing character expression and player input. (M. Mateas & Stern 2002). The player interacts through textual input which is parsed using a natural language understanding template language that maps to discourse acts (Mateas, Stern 2002). The drama manager connects the discourse acts to related thematic content and executes an appropriate story segment known as a beat (Mateas, Stern 2000). A story beat is a segment of plot that triggers related character behaviours. Once a beat has been satisfied the narrative shifts forward and the next beat is executed until finally the story reaches climax and resolution.

Interactive drama systems develop interpretive affordance through the creation of believable worlds. Expression is achieved by a combination of authorial control over narrative and the player's freedom to intervene and direct the flow of the story.

2.4.4 Installation

The following installation artists make use of expressive AI techniques by developing emotional models of character within affective spaces open to cultural interpretation. Stephen Wilson's *Excursions in Emotional Hyperspace* looks at how fictional characters might relate to one another depending on their internal personalities and emotional attitudes. (Wilson 1989) Four mannequins are placed inside a space where participants may approach and listen to feelings about the event and the space it occupies. Movement among the mannequins triggers opinionated responses to what the last mannequin had stated but from its own perspective. Although the artist concedes that each of the triggered conversations were preordained, the illusion of intelligence is created through the apparent conversation being conducted. (Wilson 1983)

Sara Roberts also looks at the affective internal space of character personalities and motivations in *Elective Affinities*. (Wilson 2002) The participant is presented with a group of four moody characters who are dealing with complex issues and relationships. If a character is approached, an internal dialog may be heard. Each has its own emotional model programmed in Hypertalk language and controlled as a network of four machines (Roberts & Sara 1997). A similar technique of modelling of emotion is developed for Naoka Tosa's *Neuro Baby*. The artist simulates a baby that responds emotionally to a participant's voice using a neural network trained to recognise the emotional tones of human voices that are mapped to specific patterns located within the network matrix. The baby triggers emotions in the form of audio samples together with a facial response expression synthesizer to create believability. (Naoko 1993). Building emotional models assist artists in building believable characters that bypass audience objectivity and communicate the cultural concerns of the work.

A similar approach applies in the creation of zoomorphic characters. Artists such as Yves Amu Klein look at 'living' autonomous creatures that contain some perceived sentience. In his project, *Octofungi* he creates an 8 legged constructed pod controlled by a neural network software architecture. The legs are moved by alloy wires and respond from a series of sensors detecting participants in the surrounding

space. The movements are gentle and react to the areas of movement giving the perception of life (Wilson 2002). The neural net brains record the movement patterns over time giving the object behavioural diversity. Attention is placed into the modeling of hormonal reactions, a life like physiological addition to the emotional model that adds to the perceived autonomy.

Believability can also be enhanced by building relationships with participants. Luc Courchesne creates installations that require participants to engage in conversation with artificial characters to explore ideas of communication within relationships. In the work, *Landscape One*, the visitors are presented with characters placed within a 360-degree scene projected by laserdisc players (Courchesne 2003). The characters will respond to set queries made through touch pads. Once a conversation has been initiated, depending on choices, a relationship is formed. Characters then may be convinced to take visitors to alternative locations building a sense of trust and affinity. These human psychological traits help foster the relationship that support the exploration of the themes.

Artists can use techniques of affective space to build expressive systems that allow user freedom. Emotional models assist with believability and the interpretive affordance that communicates the cultural concerns of the work.

2.4.4.1 Installation Artist Study - Roy Ascott

In 1983, the artist Roy Ascott staged a telematic artwork, *'La Plissure Du Texte'* for the exhibition, *'Electra: Electricity and Electronics in the Art of the XXTH Century'*, at the Musee d'Art Moderne de la ville de Paris. For a period of 12 days between December 11 to 23rd, a network of eleven artists located in various locations including the US, Canada, Europe and Australia, each contributed text to a collaborative story or in this case a "planetary fairy tale". The artwork is considered a milestone in telematic art, synthesizing ideas of collaborative storytelling and distributed authorship online. For Ascott, the project is representative of the general aims of the telematic experience, which is the "utopian potential for the global exchange of information to produce a form of consciousness which is greater than the sum of its parts". (Shanken 2000)

In discussion of the outcomes and aims of the project, it is necessary to review and understand historically the many ideas and theories that influenced Ascott. These ideas all contribute to the processes that led to the eventual inception of the artwork.

The artist's background in the visual arts assisted in the creative process through associative thought(Ascott 2004) which led him to the title of the piece, *'La Plissure Du Texte'* in reference to the pleating of the text, or in this case, the distribution of it, and is a play on words associated with Roland Barthes' *'Le Plaisir du Texte'*, one of many texts that influenced Ascott around this time. Barthes wrote of the pleasure or bliss (*jouissance*) associated with the reading of the text. Ascott (Ascott 1984)

interpreted his idea of *jouissance* to be the "coming or knowing (biblical)" associated with the text as, "pleating (plissure) is not intended to replace pleasure (plaisir), only to amplify and enhance it."

Metaphysical ideas such as these formed the basis of Ascott's search to reframe consciousness through telematic art, as he writes in '*Art and Telematics - Towards a Network Consciousness*',

"The processes of coming and going of information is wavelike, and without wishing to stretch the metaphor beyond credibility, at the full intensity of interaction in a creative networking project, these waves can extend to the most prolonged stage of *jouissance*." (Ascott 1984)

Ascott refers here to the heightened experience associated when creatively networking with other individuals and the flow or distribution of text and meaning throughout the network. For the artist, the telematic experience was essentially bound up within the concept of distributed authorship and the recontextualisation of meaning, a continual participatory experience dealing with ambiguity and "patterns of change that surge through the lines of communication" (Ascott 1984). Barthes (Barthes 1975) also alludes to the idea of distributed meaning when he states, "the generative idea that the text is made, is worked out in a perpetual interweaving".

The process of collective weaving, and analogy of the text as a textile can be understood when compared to Ascott's earlier writings on telematic art. In his essay '*Behaviorist Art and The Cybernetic Vision*', he outlays a theory on the emergence of a behavioural aesthetic within modern art, and draws on many contemporary works to support the idea that "the artwork exists in a perpetual state of transition, where the effort to establish a final resolution must come from the observer" (Ascott 1967). The artist, he proposes, now invites the observer in creative participation to extend and reinvent endless meanings and relationships within the systemic boundaries of the artefact. Behaviourist art adapts to the participant's responses and formulates a 'feedback' loop of continual output to evolve and self-organise its meaning.

These ideas of behaviour, distributed authorship and telematic consciousness led to the work, '*La Plissure Du Texte - A Collaborative Storytelling Project Involving A Computer Conferencing Network of Artists Distributed Around the Planet*'. The network was known as the ARTEX system, an email program for artists to communicate on the Sharp Associates Timesharing Network (IPSA). For the period of 12 days during the length of the project, the collaborators improvised their roles without any formal plot or structural requirements of narrative. Participants were allowed access to all other character texts in storage since their last login. Due to improvisation and time zones between participating cities much of the text fragmented and overlapped yet resulted in myriad of meanings and connotations that some describe as a surrealist game of 'Exquisite Corpse' (Ascott 2002). Others report that at each location the text appeared different such that no finalised version exists.

The mystery of these outcomes might be attributed to the limits of technology and the boundaries set by the artist. Certainly, the boundaries set by Ascott were not adhered to as participants moved beyond the

fairy tale framework intended. The technology involved however, might yield some clues as to how the process was mediated at the time. The interface itself, as Ascott (1990) discusses, is the facet with which content is inserted, transformed by the interactivity and stored. He calls to replace the status of the art object with that of the interface, which he sees as the 'doorway to undecidability' (Ascott 1990).

When considering the interface of "*La Plissure Du Texte*", the ARTEX system allows for a collective textual review and involvement yet suffers from time delays and infrequent logins such that the result produced as many nonsensical meanings to as many poetic flukes. Ascott seemed to be well aware of the relationship between telematic content and interface,

"...content of a telematic art will depend in large measure on the nature of the interface; that is, the kinds of configurations and assemblies of image, sound, and text, the kinds of restructuring and articulation of environment that telematic interactivity might yield, will be determined by the freedoms and fluidity available at the interface." (Ascott 1990)

Ascott suggests that a tactile interface might improve the telematic network as it assists in the restructuring of meaning. The interface itself, or the process of delayed time that it caused could be said to negotiate the meaning between participants, that is, the network formed a symbiotic relationship while relaying the text to the various nodes, and inadvertently subverted authorship away from the origin to the collective. In the essay, "*Gesamtdatenwerk*", Ascott (Ascott & Druckrey 1999) investigates this networked symbiotic relationship that allows for a new modalities of thought, creativity and imagination. From this point of view, he proposes humanity's need to transcend time and space through networking, and the deep psychological desire to end isolation. There is evidence to suggest that the participants felt a strong collective involvement in the experience, given that many of entries were made during the brief period of 12 days. There was also no shortage of enthusiasm; perhaps this could attributed to Barthes' idea of the *jouissance* in the text or the inherent transcendent nature of the experience.

It would interesting at this point to investigate the motivations behind the collective enthusiasm during the project. Returning to Ascott's idea of behaviour, the artist defined the conceptual boundaries of meaning by nominating a set of thematic concerns or rules associated with the artwork. These boundaries may motivate the participants to act collectively and might serve as helpful directions for the shared narrative to evolve. In the case of '*La Plissure Du Texte*', Ascott assigned a character role or identity for each of the participants who were asked to generate a segment of text from a fairy tale based on the point of view of that character. Ascott draws on the ideas of Vladimir Propp (Propp 2010) who determined a set of common narrative constituents amongst a corpus of fairy tales. Propp's analysis centred on the classification of *dramatis personae* in relation to their role in the story and the actions they take. Character actions were for Propp more important than the characters themselves and this appealed to Ascott's behavioural approach as each character is said to form a centre of action, an autonomous decentralised role distributed within a loose story framework. Decentralised character roles may have contributed to the outcomes of the work in terms of facilitating a direction or motivation for artists to

express themselves in the collective experience. The system behaviours form character constructs that collectively push the direction of the narrative.

The structural requirements of the story may also contribute to the success of distributed narrative. For this, Ascott asked the participants to form a 'planetary fairy tale' to allow for collective focus and create the circumstances for collaboration within a shared mental space. Perhaps Ascott is attempting to develop the shared ideas of a mythological construct, that is, to identify the commonalities of story that exists within the collective mind. Mythology and archetypal knowledge might play a significant role in developing collective narrative ideas while the freedom of meaning and reinterpretation is left with the participants to create for themselves. These are ideas that he refers to in an earlier essay, "*Behaviourables and Futuribles*",

All in all, we are still bound up with the search for myths. But the context will be biological and behavioural—zooming through the micro/ macro levels. Get ready for the great bio-myths, visceral legends. (Ascott 1967)

Ascott identifies two interesting concepts, the behavioural, which guide the limits of systemic interpretation, and the mythological search, or the collective ideal with which it is possible to consciously connect several meanings into a coherent narrative pattern or direction. This could possibly represent Ascott's notion that the *jouissance* of the text forms a biblical "knowing", that being the mythological. Ascott identifies several of these concepts in his theory of the "*Cybernetic Art Matrix*", which he defines as a projection of our behavioural culture, a futurist metaphor open to speculation and alternative thought based on our historical understanding (Ascott 1967). From this he cites the structuralist notion that,

“Only through myth and the structures it requires can we combine the necessary paradox of definition and ambiguity, of order and uncertainty, of the tangible and the infinite” (Levi-Strauss).

This concludes that the possibility of collaborative narrative with its inherent ambiguity can coexist with the possible structural metaphors of myth. The process of the collaborative fairy tale in "*La Plissure Du Texte*" sort to combine the layered meanings through characterization and mythological construct.

It is interesting to compare some of Ascott's later theories (1989, 1990, 1998) with his intentions of "*La Plissure Du Texte*". Early experiments in telematic art show the focus on participation over observation. Participation was later identified by Ascott to be intrinsically associated with intimacy. The subject of intimacy within telematic art was a motivating concern for Ascott in his deliberations on consciousness, as he wrote, "It is the question of intimacy in the relationship between the individual and cyberspace, which must be at the heart of any research into technologically assisted construction of reality' (Ascott 1998). If this is the case, the question remains if the participants of "*La Plissure Du Texte*" were intimately involved in the experience, and did this contribute to the reframing of the conscious state.

In the essay, *'Is There Love In The Telematic Embrace?'*, (Ascott 1990) calls attention to the idea that telematic art will eventually embrace and re-invent the many facets of human nature. He makes the claim that telematic networking could potentially enhance and extend our relationships and extend our collective intelligence and perception.

"As for conscious experience in itself, while there is nothing we know more intimately than our inner sense of being, there is nothing we can experience with less comprehension than the conscious states of another. It may be only the profound empathy of mutual attraction, 'love' if you will, that can break this barrier. " (Ascott 1990)

It is uncertain that the participants felt the level of intimacy required for such a connection, although it has been established that they were enthusiastically involved. The measure of such emotion is hard to assess but we can assume that the participants were involved on some intimate level and perhaps conclude that their conscious states were transcending distance and existed in a shared collaborative virtual space.

It is Ascott's later essays (Ascott 1998; Ascott 1999) that he attempts to understand the transcendent nature of networking and the telematic experience. Ascott's interest lies in the expansion of mediated consciousness in cooperative environments and this reflects the intentions of *"La Plissure Du Texte"* beyond the narrative boundaries that were set. In these later writings, Ascott looks to resolve the process by which individuals openly participate in the collective experience. Shared consciousness, it could be said, is the ultimate goal of all telematic art. However, the division of participant and observer often inhibits this state. The passivity of the observer, Ascott claims, curtails the emergence of unlimited meaning and limits the reframing of consciousness. Telematic art, it could be said, when placed into a museum context fundamentally fails to attain the collective consciousness or intimacy since it is open to public observation. *"La Plissure Du Texte"* was partially open to public observation at the Electra festival, yet in viewing the text, most of the involvement or enthusiasm seems to come from the remote locations. From this example, telematic art possibly benefits from the removal of public observation or scrutiny. At least, this theory might hold true by examining the outcomes. The level of participation and interplay shown by the remote participants seems to support Ascott's theory of the observer/participant dichotomy.

If shared consciousness is the goal of telematic art, and the participants of *"La Plissure Du Texte"* were enthusiastic enough to contribute to the experience, the question remains as to how they came to be motivated. The participants were assigned roles to play within the experience, such that they had to perform some action yet it is possible that they were giving something else beyond a performance. Ascott discusses the role of drama and performance in telematic art in the essay *'Enactment and Emergence in the Dramaturgy of Artificial Life'* where he defines the essential difference between 'enactment' over 'performance' (Ascott 1998). Enactment is concerned with the collective idea of consciously acting out movements and gestures in-group situations akin to ancient ideas of ritual and ceremony. The primary

difference with performance, being the absence of audience. In the enactment, the audience becomes the participant by conscious choice. It is interesting to compare this idea with the outcomes of *"La Plissure Du Texte"*, as the participants had a role to play yet superseded the need for any narrative direction, at least Ascott did not give any structural requirements beyond the fairy tale construct. From this it would be interesting to ask the question, if the audience simply performed their roles or attempted to enact or extend their own needs or conscious ideas through the role-playing. There is evidence to suggest the latter, as the outcome shows the construct of the fairy tale was obviously extended by the freedom of ideas, theories and thoughts of the participants throughout the duration of the exhibition. A conclusion could be reached that telematic art experiments such as *"La Plissure Du Texte"*, benefited from collective enactment by placing less restrictions on narrative structure or less stringent requirements on the role of character. Thus facilitating the extension of meaning is the aim of the artwork and perhaps all telematic art as it essentially operates through a shared conscious participation.

"La Plissure Du Texte" represents the inception of ideas forming the basis of all telematic art involving distributed authorship. It exhibits all of Ascott's important theories of behaviour, intimacy and enactment. System behaviour forms the basis of characterization needed for narrative ideas to flourish, and the boundaries of meaning set by the fairy tale mythological construct. Participation in telematic art invites a level of intimate involvement that may be enacted out in a collective environment. This conscious involvement by nature transcends time and space and is mediated by a symbiotic relationship to the network. *"La Plissure Du Texte"* is an important artwork, as it was the first of its kind to exhibit the essential processes and aims of multi-user collaborative online spaces that are concerned with distributed authorship and interactive storytelling.

2.4.5 Conclusion

The artworks detailed in this survey offer models of expressive AI systems that the artist has either intentionally or unintentionally formulated. They all apply techniques of embodiment with affective behaviour either in layered and hierarchical manner that immerse the participant in believable atmospheres. Careful authoring of behaviour allows the artist to maintain the interpretive layer of affordance that is indicative of expressive systems. Further research into tools and techniques of applying expression to artificial intelligence systems may allow for greater scope of audience participation and interpretation of the artworks.

2.5 Interactive Digital Storytelling Systems

2.5.1. Introduction

The application of storytelling and drama within games is considered a complicated design issue that attempts to balance the tension between linear narrative elements and the immediacy of game play. The issue has raised a theoretical debate that looks to separate game studies, or ludology (Frasca 1999) from other forms of narrative, such as drama or film. This theory identifies games as having their own unique formal structure made up of abstract rules (Hartmann et al. 2005). Therefore, it is argued that game studies should be devoted to the study of these rule systems not to their apparent representative forms. However, there has been some recent confusion over the real definition of the debate and the exact relationship that narrative has to games. Some theorists are asking for a theory of narrative applicable to games (Frasca 2003) while others are saying the debate never existed in the first place (Murray 2005).

While theorists concentrate on the implications of narrative within games, researchers look to prototype specific systems that are capable of integrating storytelling and drama with interactive game worlds. This review will compare a range of interactive storytelling and drama systems currently in development with particular focus on empirical evidence and demonstrative examples. Common theoretical and technical approaches will be highlighted in an effort to summarise the approaches that are most beneficial to game developers. Three major design issues are of concern when implementing interactive storytelling systems, each will be summarised and detailed in the subsequent sections.

2.5.1.1 Design Consideration – Narrative Segment Delivery

The first design issue being the deconstruction of narrative into segmented form. The segments are delivered by distributed means in accordance with player's actions, character roles and the status of the game world. They are then dynamically recombined and presented to form an overall narrative and eventual climax or resolution that is meaningful to the player. Narrative is distributed through a number of means such as character models of behaviour, motivation and task declaration or by classifying the thematic concerns of the story. Behaviour and tasks are typically managed by conditional means such that narrative progression may be monitored by the successful completion of set tasks. Eventually the progression must be evaluated in some way to denote the presentation of key events such as climax and eventual transformation of the story and/or characters.

2.5.1.2 Design Consideration – Player Agency and Immersion

The second design issue arises from the needs of player agency and immersion. Interactive drama authors look to techniques of suspension of disbelief to tell their stories. To support believable worlds, representations of character are seen to be useful in relaying thematic concerns. Authors embody

emotional and psychological models of human behaviour in their characters to support a convincing environment. Character actions, tasks, motivations and non-repetitive behaviour all contribute to the belief of story.

2.5.1.3 Design Consideration – Player Interaction vs Narrative

The final issue is concerned with the player's interaction. Interactive drama systems require a balance of user interaction versus story structure that allows for the illusion of free play and the emergence of narrative. Freedom of play, or at least the illusion of it, is of prime importance to the story delivery of interactive drama. The player must be given the choice to act out, play an important role within the story, and live the consequences of the actions they take. For the player's agency to be maintained these actions must be seen to affect the story world without openly conflicting with the narrative's structural limits.

2.5.2. Narration

Interactive storytelling systems attempt to implement new forms of narrative structure that may be applicable to interactive game play. The narration of story looks to manage or adapt to the circumstances of player interaction by distributing story structure into a segmented form that may be delivered in multiple ways. Delivery of segments are subject to rules and world conditions set by the author. Once certain conditions are met, the story may be evaluated and eventually transformed into a common outcome or resolution.

2.5.2.1 Structure and Management

Interactive drama researchers look for structural patterns in narrative that may be derived from a series of casual events within a story world (Riedl & Young 2004; Marc Cavazza et al. 2002). Narrative structure is open to classification such that the next event of the story may be identified from the history of the player's actions and the current state of the story world. The imposition of structure in a non-linear story matrix is often managed by a separate system or agent that analyses the story world state to maintain the pace and dramatic flow (M. Mateas & Stern 2002). Management of systems can be said to have two separate approaches: character based or author centric.

Character based approaches look to form narrative structure from a cast of autonomous characters who are assigned story tasks and motivations (M. Mateas & Stern 2002) (Marc Cavazza et al. 2002, M. Mateas & Stern 2002). The integration of character tasks with player input constitutes a set of authorial themes that mold the story. Author centric approaches attempt to adapt or classify a narrative structure surrounding free play to keep tight control of progression and pace (Steiner & Tomkins 2004; Hartmann et al. 2005).

Some systems however, tend to use a combination of both character and author based approaches. Riedl and Young (2003) and Cavazza et al (2002) both develop narrative structure from the combined activity of autonomous characters. This approach manages the story conditions based on character and player states in the world. In Riedl and Young's *Actor Conference System*, a blackboard hierarchical model of plot actions connected by partial solutions or hypotheses is connected to a set of characters with their own internal hierarchies. Hypotheses are validated from reliance on success of character hierarchies that in turn allows for narrative progression. A similar method is proposed by Cavazza et al (2002) who define story goals within the management hierarchy while allowing characters their own internal hierarchies for management of motivational concerns. Both these systems use planning algorithms to search the abstract hierarchy when constructing possible story directions. Casual linkages of story events and character tasks are traversed and a planned course of action is determined from a current story state. These researchers both consider planning to be a useful method of maintaining authorial control over autonomous characters.

Szilas & Rety (2004) also use a combined hierarchical approach. They derive narrative coherence from a series of specific task/action modules with story goals. Task and goal combinations may be dynamically connected to story characters allowing for many permutations. Story goals are maintained as hierarchical networks so that each sub-goal may be evaluated before executing the parent goals.

Interactive drama researchers apply theories of linear narrative structure and classification to support dynamic non-linear engagement. Mateas (2001) looks to classic Aristotelian dramatic theory as a model for narrative construction. The system of management, known as drama management, identifies a constant rise in dramatic tension until a climatic point is reached followed by resolution. Dramatic tension is equated with the ongoing presentation of the narrative elements that increment the position of the story state.

Other researchers look to systems of narrative classification. Hartmann et al (2005) propose a system based on Propp's classification of fairy tales in which they define a tool that allows authors to input motifs and the strength of interconnectedness within the story framework. Motifs are classified based on their semantic connections; story structure is derived on this basis.

Steiner & Tomkins (2004) propose a system that dynamically adapts to world conditions based on conditional rules. This depends on the current spatial arrangements of the players and the characters. For example, if the player is not directly viewing an important story event, the system looks for alternative dialogue or actions as notification that the specific event has occurred.

Combined approaches appear to have more success in maintaining agency while author centric systems, such as the adaptive system of Steiner and Tomkins (2004), report the apparent loss of story pace. Knickmeyer & Mateas (2005) present evidence to suggest that the *Facade* system Mateas & Stern, (

2003) manages story stoppages or failures in a graceful manner, which may actually increase agency and player interaction.

2.5.2.2 Segmentation

Story events either generated through the player's actions or the actions of characters are related to narrative segments contained within formalised story structures. Similarities between segments of narrative can be seen in many formal structures of storytelling. Researchers exploit this notion to select the appropriate story based on the interaction of the player.

Hartmann et al. (2005) subdivide the story into a collection of interconnected motifs and scenes. A scene may be dynamically assigned to a motif depending on the story that is being played out. The method contains character actions and the narrative segment together within the specific motif to maintain tight control of narrative.

Applying character behaviours to specific narrative segments is also seen in character centric approaches, however the character behaviour tends to affect the narrative outcomes rather than the narrative segment triggering preset character dialogue. Mateas and Stern (2002) identify a segment of narrative as a *beat*. Each narrative beat is placed into sequential order based on the current progress of the story, such that the order of beats is continually evaluated and recombined based on player input. Each beat is representative as a collection of character behaviours encompassing the requirements of the plot segment. This common technique of disseminating narrative within behavioural character groups can also be seen in Riedl et al (2003) and the Cavazza et al (2002) model. Characters have their own personality rule based system with a plan of action that relates to particular narrative elements containing the character's intended purpose within the story. Cavazza et al (2003) also propose a similar system that distributes narrative between the various character roles and actions. A planning algorithm is used for each character role that extrapolates a narrative from their subsequent interactions.

Character based designs allow for more freedom of story diversity while narrative based approaches tend to maintain tighter control. It is harder to assess which method is more successful; generally, it is dependent on story itself. Mateas and Stern (2003) model stories that depend largely on character motivations but this might not be suitable when implementing tight structural narratives such as mythological stories.

2.5.2.3 Rules and Conditions

Ludologists claim that games are essentially formal structures of rules with little or no relation to the narrative structures they embody (Juul 2001). Whether or not games and narrative are mutually exclusive, rules and conditions play an essential part in interactive drama and storytelling systems. Conditionals allow authors to impart the essential requirements of the plot to control delivery and pace of

story. Rules and conditions are also essential in the control of autonomous characters to stay within the boundaries of their personalities.

Those researchers using the character-based approach tend to place plot limits within specific character behaviours. Mateas and Stern (2002) define this as the *precondition*. This simply identifies if a subset of behaviours should trigger given the correct status of the game world. Furthermore, behavioural preconditions are placed with a hierarchy of behaviours and are subject to the success or failure of their parent behaviours. A somewhat similar technique is seen in (Riedl & Michael Young 2003) and the (Marc Cavazza et al. 2002) model. These systems use expert or rule based systems that exist in hierarchical form and are subject to story world conditions.

2.5.2.4 Evaluation and Transformation

Interactive storytelling systems often associate plot segments or thematic concerns with system values so that a narrative may be assessed on its current progress. Transformation in the classic narrative sense means the fundamental change of story situation, typically made by the protagonist. Researchers attempt to evaluate the narrative progress in an attempt to induce the situation to transform (M. Mateas & Stern 2002, Szilas & Rety 2004, Hartmann et al. 2005, M. Cavazza et al. 2002). The author can define certain values that constitute progress in the story, thus influencing the order of events yet allowing for flexibility in the game's overall progress. The ordering of events is under constant flux depending on the current story values generated by the player. The story values can increment through a number of narrative means yet eventually transform the story into similar outcomes.

Mateas and Stern (2002) develop the idea of story values that are representative of themes within the narrative, and associate those values with the successful completion of narrative segments. By adopting Aristotle's method of dramatic climax, they seek to progress the story by incrementing the values until the story has reached a climatic point. Szilas and Rety (2004) use a similar technique of thematic association but also adopt negative evaluation. Each story task is understood to be a story metaphor that may be considered axiological, adding further depth and possible positive or negative outcomes. An axiological approach is also seen in the Hartmann et al (2003) model that looks to place a value on the alternatives available to the player when navigating various motifs.

Story values present interactive drama systems with the ability to translate narrative ideas or themes into computational segments. They give systems an additional assessment mechanism that can finely tune narrative events. The additional use of negative values can also translate as the positive and negative aspects of dramatic events and bring greater diversity in management of these themes.

2.5.3. Characterization

Interactive drama systems often rely on character centric approaches in construction of emergent stories. Typically, characters that exhibit expressive qualities are considered believable, and this results in a greater sense of player agency. According to player actions, characters respond in expressive ways that fit within their personality models and motivations in the story world. The character behaviours and plans all collectively contribute to an overall narrative or story.

2.5.3.1 Behaviour and Expression

Researchers translate character motivations and personality into behavioural constructs by the use of concurrent languages, such as ABL (Mateas & Stern, 2002) or Gertie (Loyall et al. 2004), or through knowledge hierarchies (Riedl et al 2003; Cavazza et al 2003). Both methods offer systems of containing personality and idiosyncratic behaviour within specific narrative contexts. Interactive drama systems that contain behaviour in this way are known as character based systems out of which narrative outcomes emerge through character action. Character expression and narrative delivery are of equal importance, thus it is recognized that a versatile behaviour model is the favourable method to deliver story elements that create an immersive experience for the player.

An expressive behavioural language is considered an important feature in the creation of believable characters. The language must be capable of handling segments of behavioural conditions that are contained in hierarchical form and subject to the success or failure of their parent behaviours. Furthermore, the behaviour language is enhanced by its ability to execute actions concurrently, yet is also capable of responding to conditional means set by its emotional personality traits, the player's interaction and the state of the story world. Researchers call this a *precondition* (Mateas & Stern, 2002; Loyall et al, 2004), this simply identifies if a subset of behaviours should trigger given the appropriate status of the game world.

Though the separation of behavioural aspects into high level actions, such as cognitive, emotional, and low level; response to world stimuli, researchers are able to create an expressive framework of personality and believability (Loyall et al, 2004; Mateas & Stern, 2002; (Prendinger & Ishizuka 2001). From the high level actions, it is possible to identify the characters primary motivations or what fundamental actions are persistent (Loyall et al, 2004; Mateas & Stern, 2002). Persistent action outcomes may be subject to low-level actions, such as an action of another character or the player. Beyond these fundamentals, character behaviour may be layered to deal with other important issues such as reflective attitudes, changes in thought patterns and even staging issues or an understanding of the player's viewpoint in the world (Loyall et al, 2004). Some suggest that there is an inherent complexity with behavioural authoring using concurrent languages, leading to internal character behaviours clashing (Mateas & Stern, 2002), yet these issues may in fact add to the expressive nature of characters as perceived by the player (Loyall et al, 2004).

Expert systems or similar models of knowledge representation are another method of character behaviour modelling. (Riedl et al 2003; Cavazza et al 2003). These systems are rule-based systems that exist in abstract hierarchical form. Cavazza et al (2002) separate these hierarchies, they call *Hierarchical Task Networks* (HTN), into a subset of behaviours for specific character plans. Each plan is triggered by a story world condition or an emotional response to an unexpected event not coordinated by the overall narrative planner, or the story HTN. Expression and reactive emotions are reflected in heuristic values associated with the execution of the hierarchies (Riedl and Young, 2004).

Systems that implement planning in rule hierarchies (Riedl et al 2003; Cavazza et al 2003) allow for tighter narrative control, yet perhaps do not allow for the flexibility of expression seen in systems using behavioural language (Loyall et al, 2004; Mateas & Stern, 2002). In interactive drama systems, the importance of expressive characters weigh evenly with maintaining control of narrative structure. However, in the likely scenario where narrative does not emerge from character behaviour, the player will still maintain an immersive experience based on the depth of character personality (Mallon & Webb 2005). From this conclusion, it might be established that a rich behavioural language exhibiting all the expressive needs of character may be an essential element within the system design.

2.5.3.2 Believability and Reactivity

Character belief is of importance to interactive storytelling researchers. Belief of a character comes from its motivations and psychological attitudes with respect to the story and the world it inhabits. These characters are designed to react, as opposed to responding directly to player input thus displaying a psychological profile that is interpreted as human-like qualities. Therefore, systems that create believable characters must look to implement aspects including personality, emotion and story intention. Furthermore, the system needs the ability to cope with unplanned situations such as a misunderstood action by the player and offer alternative actions and dialogue.

Researchers look to implement a reactive model that attempts to separate a character's physical actions and from its emotional involvement (Loyall et al, 2004) (Prendinger & Ishizuka 2001). Such systems identify physical actions as 'low level' while behaviour and emotion are considered mid to higher level functions. This model allows for reactivity to specific situations such as a character reflecting emotionally to a physical action it has taken, or some failed consequence of its behaviour. Mateas and Stern (2002) also develop a similar reactive model but embody all actions and emotional content within one character model. As Loyall et al (2004) point out, they tend to concentrate on higher level cognitive functions rather than direct actions. Both systems however, result in believable character reactions that are identified by players as affective responses that serve to increase involvement in the story world.

Riedle and Young (2004) concentrate on two factors to achieve character believability, these being intentionality and personality. They correctly point out that character intention is one defining aspect of character believability, that ultimately communicates its contribution to a perceived narrative. Intention supplies the character with set goals in the narrative, and planning is used to determine the appropriate course of action. However, all autonomous planned action for each character is compared to the overall plan of the story to maintain plot coherence. Intentional acts are therefore determined as coherent before allowing the action to go ahead. However, characters also create acts that fit within their own personality framework rather than the expected way an audience might attribute an obvious narrative outcome, giving an added depth of realism. The use of heuristic search planning (Riedl et al 2003; Cavazza et al 2003) of character task networks finds a connection with the characters intention rather than the aligning with the narrative plan.

Systems that create believable characters must look to fail elegantly and deal with issues arising from the misunderstood intentions of the player. Characters who misunderstand actions or input from players must respond in realistic ways to maintain interest in the story world. (Knickmeyer & Mateas 2005) present evidence to suggest that character based systems can maintain player agency and interest in personality and background stories of characters in the event of a system failure. In the case of their *Facade* system (Mateas and Stern, 2002), the characters look for alternatives in the story or reflect upon other personality issues that serve to reveal more about themselves and create psychological depth. Riedle and Young's (2004) system also allows for what they term as a 'flawed plan' or a plan constructed by the character that does not fit coherently in the narrative. Characters look to form hypotheses or 'cast calls' that ask the narrative manager to coordinate other characters to assist in the story plans. If a coordinated story plan is impossible, the character planner revisits or backtracks in the hypothesis search space to determine if any partial solutions are possible. The ability to cope with unexpected story actions may be an essential part of character design if the system is to maintain player agency and in the case of some systems (Mateas and Stern, 2002), serve as a mechanism to encourage engagement.

Believability is not promoted by repetitive dialogue and action as they are perceived as robotic and inhuman to a player and are considered a source of general annoyance (Mallon & Webb 2005). Mateas and Stern (2002) offer story characters that often reflect and return to thematic concerns through alternative means such as using slightly different sequences or dialogue. Systems that develop differing character moods and personality in response to game status and player involvement add psychological depth, (Silverman et al. 2003) (Mateas and Stern, 2002) and are considered to be engaging aspects of the story world (Mallon and Webb, 2005).

Character belief must actively work to support the emergence of narrative aspects. Systems that offer the player alternative means to emerge story aspects through character behaviour are considered to increase agency and enjoyment.

2.5.3.3 Emotion and Psychology

Players respond favourably to characters that display complex emotion and personality (Mallon and Webb, 2005) and these aspects serve to increase player agency and engagement with the story. The relationships that a player forms with characters also assist with agency (Mallon & Webb, 2005), therefore a model of emotion is favoured as a method of creating characters with psychological depth. Using behaviour languages, researchers are able to construct rudimentary forms of emotional models (Loyall et al, 2004; Mateas & Stern, 2002; Prendiger et al, 2002). These emotional models allow characters to reflect on actions taken by themselves and/or by the player and compare this to its internal nature, as designed by the story author. Characters might be authored to react emotionally to particular incidents that are indicative of their personality types. This response might affect the characters attitude over the course of the game and play a role with its relationship to the player.

Characters that give attitudinal changes over the course of the story are considered as having greater psychological depth (Loyall et al, 2004; Prendiger et al, 2002; Silvermann et al, 2003) and allow the player to see the consequences of their actions in the story. Loyall et al (2004) use behavioural techniques to associate body reactions such as facial reactions with emotion responses. Emotional and affective responses can clearly be considered as an essential part in the creation of believable characters and assist in an emotional and potentially cathartic experience for the player.

2.5.4. Interaction

All interactive drama systems take into account the combination of player agency and interaction in the story world. To present the best model of interaction for systems, researchers must consider the user interface and its linguistic possibilities for player communication. The interface must also look to offer a set of affordances (Norman 1995) that best suite the aims of the story without placing noticeable limitations or boundaries that interfere with player agency. Finally, the story world must adapt in particular ways to interaction, that is, the narrative and character relationships should reflect the consequence of player action.

2.5.4.1 Interface

Beyond point and click interfaces, interactive drama systems benefit from a user interface that involves a high level of conversational ability (Mateas & Stern, 2002). Crawford(Crawford 2004)defines interactivity as a conversation, a process of speaking, listening and thinking, and is best designed when taking into consideration these aspects of human communication. When considering interactivity for interactive drama systems, a conversational interface supports the level of communication required to form relationships with the characters in the story. Systems use natural language parsing to match templates of language with the internal story themes (Mateas & Stern, 2002) or character plans (Cavazza

et al 2002). This allows the player to interact on a deeper level and become more involved with the character personalities, rather an observer that just refers to objects or spatial metaphors to communicate.

Artefacts or spatial arrangements can however, assist in the narrative possibilities. Objects may take on specific narrative attributes when referred to by characters (Cavazza et al 2002), thus the player can benefit from a direct manipulative interface such as a 3D representative world. The 3D story world may be inhabited by characters placed in spatial arrangements for specific narrative intentions (Cavazza et al 2002; Mateas & Stern, 2002).

Combined approaches between conversational and spatial interface metaphors appear to provide the player with the necessary tools to assist in the type of user interface that facilitates conversation and gesture. From this, it might be considered that these are the tools that best provide the immersive experience needed for interactive storytelling systems.

2.5.4.2 Affordance

Well-designed interactive storytelling systems allow players the freedom to make choices that affect the story outcomes. Systems desire the facility to invite player interaction, that is, to allow interpretive affordance (Mateas 2001) for what is possible within the system boundaries. The concept of affordance (Norman 1999) stems from the narrative possibilities of artefacts, character interaction, and spatial arrangement of the story world (Cavazza et al 2002). Affordance deals with issues of the audience relationship to the story world and directly supports the explanation of the system's behaviour (M. Mateas 2001). It is also reliant on the application of the story within the system. Crawford (2005) identifies this concept as 'verb thinking', or simply designing the game around the idea of what is possible to do rather than what exists. The possibility of action within the game space is limited by the type of story being applied to systems.

Character based systems tend to identify more with affordance (Mateas & Stern 2002; Cavazza et al 2002), as these systems apply behavioural structures to construct relationships with the audience. There is evidence to suggest that the forming of character relationships can enhance interactivity for the player (Mallon & Webb 2005). Mateas and Stern (2002) develop the idea of character affordance by considering the audience interpretation of the character's thought patterns, such as its goals or motivations. This interpretation formulates the most apparent action that the player can take within the story while not actually limiting the range of choices the player can make (Mateas and Stern 2002). Therefore, it is possible to present the circumstances that will most likely have a direct effect within the story without placing noticeable boundaries that only serve to inhibit player agency.

System design that accounts for the audience relationship to the game world can assist authors in creating the necessary pace of dramatic circumstances. Players must feel as though they are making a meaningful

contribution to the story and affordance gives the necessary direction of action for the player without placing limits on the choice.

2.5.4.3 Consequence

Understanding the consequences of action may lead to a greater level of agency (Mallon & Webb, 2004). A player must comprehend the changing nature of character relationships and story outcomes to become more involved in a narrative. Researchers look to develop ongoing character relationships as a way to show players that their actions have real consequences in the eventual outcomes of story (Mateas & Stern, 2002; Silvermann et al 2003). The repetitive exploration of situations can lead to an understanding of how best to achieve the intended outcome or an understanding of consequence. This is particularly relevant for interactive stories with pedagogical concerns. (Silvermann et al, 2003). Adjustments of character personality and response can motivate players to replay the game in an effort to understand more about the characters (Knickmeyer & Mateas, 2005). A systems ability to handle replay and differing outcomes allows player's more involvement with understanding character back-story and motivation, and will assist a player to understand their own intent within the narrative.

2.5.5. Conclusion

This review has compared a series of interactive storytelling systems that are in current development and prototyping stages. Although these systems form relatively new conceptual ideas, they present some common techniques that are shown to be workable approaches for game development.

System design that facilitates a combined approach of distributed narrative with character based approaches and some authorial management has shown to be most beneficial in presentation of story without affecting player agency. The distribution of narrative may be best implemented through behavioural modeling languages that are tailored for believable and lifelike characters. Character based designs also allow for freedom to diversify emergent narrative without the imperative need for a definitive outcome of the story, since the depth and believability of the characters enhance the immersive nature of the story world and maintain agency.

Believable characters are considered important aspects that carry the experience by maintaining active roles in the thematic components of the story, while acting out their own personal and motivational concerns. They add the necessary depth and personality that engages the player to form relationships and understanding which serves the overall authorial intention.

Authorial concerns may be best expressed by consideration of the interpretive affordance of the characters and the story elements that offer a direction of action without openly limiting choice. Player's may meaningfully contribute to the story if presented with highly interactive interfaces that are capable of

conversational and linguistic communication in addition to spatial metaphors, which all serve to maintain active engagement.

Currently, there are basic system examples that show interesting promise and ground breaking results. The challenges for these systems lie in their need to be scalable and adaptable to a diverse range of narratives. The complexity with system design will shift more towards actual techniques of story and character authoring using the behaviour languages and architectures provided by these systems. Further breakthroughs may be possible by developing larger and more interesting stories containing characters with greater complexity. Once these authorial techniques have been established, this will allow for greater participation from game writers and designers.

2.6 Developing Emergent Play

This section will discuss common features of emergent play and how they are applicable to collaborative systems that develop narrative emergence. Systems that develop emergent game play allow for greater creative possibilities while maintaining participant engagement. Emergent play features, such as development of fictional worlds will be discussed, followed by a discussion of player experience of emergent play. It is found that narrative emergent play is facilitated by a set of clearly defined and simplified affordances that provide recognisable metaphors for collaboration. Understanding key design features in emergent systems along with theoretical implications will assist in developing of appropriate interface mechanics to enhance emergent play and narrative.

2.6.1 Interface

Emergence in games is considered a fundamental game feature where collections of simple rules gives rise to new variations on behaviour or outcomes (Juul 2002). In the context of play within games and other interactive media including playable games (Ryan 2009), emergence is considered the most appealing of designs. As it allows for such narrative possibilities as re-playability and player generated creativity with full agency and immersive qualities.

Given the established problems with narrative and player agency (S. Louchart & Aylett 2004) researchers are identifying common design features that generate emergent play. These can be considered applicable to both games and play, as the notable differences in how a narrative coherence is generated, either directed by top down processes, such as a drama management (Swartjes & Theune 2006) or a bottom-up driven experience with the latter as the design goal of most desirability.

Two notable features will be discussed here, firstly the identification of boundaries that develop narrative coherence including fictional worlds, story worlds or contextual frames that place limits on emergence. Following this, the player experience of narrative emergence and possible solutions to maintaining collaborative engagement through an improvisational play.

2.6.2 Fictional World Coherence

Researchers of emergent narrative and play for digital experiences identify the development of the fictional world as basis for developing player or character based generated narratives. The experience of narrative differs greatly to the perception of narrative within films. For example, temporal events in games connects the play time, or discourse of the narrative (the sequence of events) directly with fictional time, or how the events are told (Juul 2011). Game narrative becomes problematic when presenting fictional time in any achronological order commonly seen in films or fiction. Narrative is rather a direct consequence of player action and not perceived as the action evolves. This paradox of narrative comprehension in games has shifted research into understanding how narrative emergence may develop directly in fictional worlds.

Games excel at the development of fictional worlds providing player agency and emergent play (Jenkins 2004) with rich story-building features constructed by player activities. They contain spatial metaphors that develop narrative possibilities suggesting interfaces may play a prominent role in player developed narratives. Fictional world metaphors are linked with aspects of the real world that exhibit recognisable, familiar activities and also places boundaries on context. Defining contextual boundaries (Suttie et al. 2013) contains the possibility space for emergence and maintains coherence through limitation. For a consistent and coherent world this is necessity as the link between emergent play, story and social world is deeply intertwined (Pearce 2006). A play boundary in this case may just be an implicit or innate agreement on how to act, such as a 'magic circle' (Salen & Zimmerman 2004) or player attitude (Suits & Hurka 2005) or by placing specific design limitations on behaviour to contain emergence (Eladhari et al. 2011).

Fictional worlds that aim for coherence should be designed to develop implicit events (Spierling 2007) rather than explicitly authoring sequences that will potentially exhaust the system of interesting outcomes. A good example of this can be seen in Minecraft (Persson 2011), a successful player driven fictional world where activities mirror aspects of real world construction. However, the true success of the Minecraft experience is largely dependent on social aspects of co-creativity and community engagement. For this reason, emergent fictional worlds need the drivers of collaboration and community to develop creative potential.

2.6.3 Player Experience and Participation

The narrative paradox as outlined by (Louchart et al. 2008) and others suggests emergent play and narrative would benefit from a character based model where specific behaviours may be interpreted by the player and a narrative induced from these collective environmental cues. This presents further issues in maintaining narrative comprehension as it requires the active involvement of the player in the experience.

Players of emergent experiences are heavily dependent on the act of co-creation and collaboration for emergent narrative to be recognised at a macro level. Such an experience would require the player to act in similar ways to an improvisational actor with some understanding of narrative consequences based on actions of themselves and others. This has been discussed (Sandy Louchart & Aylett 2004, Swartjes & Theune 2009, Fuller & Magerko 2010) and further evaluated as a possible scenario (Magerko et al. 2009) of emergent development of interactive digital narrative. The findings conclude that actors develop shared mental models and cognitive converge over specific dramatic performances that drive narrative forward.

Cognitive patterns such as these could be useful for understanding design for emergent play with actors who have the appropriate concern for the mutual progression of the narrative scenario. However the issue is that players are generally not trained as improvisational actors nor are they necessarily open to cues for collaboration. For design of emergent play, providing these cues can equip players with the tools they need to perform more like actors sensitive to the narrative context at hand. As such, developing interface metaphors that describe or explain the simple actions possible in the fictional environment in contrast with the familiar actions in the real world, can demonstrate how to act accordingly. This type of metaphor can also be described as an affordance (Gibson 1977) and provides an innate understanding of how to perform within the environment.

Players perceive affordances they see in the fictional world and understand them through the affordances they commonly associate with the real world (Gee 2008). In other words, they import the knowledge from their interaction of the real environment to understand how to act in the fictional world. This is akin to a conversation where embodiment, or innate knowledge of how the body acts within the world, can be transferred or hybridised with the game world.

This notion of an innate affordance stems from the theory of situated and embodied cognition (Hutchins 1995, Clark & Chalmers 1998), that states our bodies share in part responsibility for the way we comprehend the environment. This theory has already had some impact in the fields of human-computer interface (HCI) (Dourish 2004) and is further discussed for its applicability to game play and player experience (Gee 2008, Arjoranta n.d., Rambusch 2006).

Situated cognition also has interesting implications for emergent game design and especially relates to aspects of interaction design and online player experiences. Researchers are evaluating the possibility of developing appropriate interface mechanics to enhance emergent play and narrative. (Freeman et al. 2013, Alofs et al. 2012).

Designing appropriate affordances will encourage players to perform more like actors and develop a level of collaborative engagement that produces more variations of behaviour and novel outcomes. Further

studies into motivations and aspects of play-style with emergent games (Canossa 2012) would also further techniques on how to develop such affordances.

2.7 Discussion

This chapter has outlined a range of literature from diverse fields that attempt to synthesise a clear direction for design of collaborative semi-autonomous systems that produce novelty. Built upon concepts of narrative psychology, or the narrative construction of reality, it suggests a strong historical relationship to open meaning generation by communities and groups. The history of metaphor generation is a collective approach generated by years of cultural appropriation by communities and drives the creative approaches to any collaboration. These primal metaphors that are retained within the body, guided the narrative accrual of meaning. These collective meanings are a powerful tool for designers as they are instantly recognisable and do not require detailed explanation.

Within these meanings are sets of relationships surrounding cultural norms that are implicit. From this, narrative coherence can emerge without explicitly placing those relationships directly within a system design and limiting its range of output. This refers to the expressiveness of a system design where the behavioral features of a system are open to interpretive affordances of its participants and meet within specific cultural contexts. This understanding has led to interesting outcomes for semi-autonomous systems with artificial intelligence within the fields of games, robotics and interactive installations.

To further this understanding, a comprehensive review of interactive digital storytelling systems was conducted to understand the range of options available specifically related to approaches in artificial intelligence and the larger issues of coherent narrative generation. This area of research tends more towards understanding the formalisms behind narrative generation and also its theoretical applicability through developing sophisticated prototypes. These tend to fall between character and authorial approaches to narrative management and have significant applicability to narrative coherence and collaborative semi-autonomous systems. These efforts show the complexity of the problem to narrative coherence and interactivity as few good examples exist that cater to real emergent narrative solutions.

The chapter then looked at emergent play in relationship to emergent narrative for design features. In general, these features of fictional world boundaries and player affordances suggest ways of containing meaning within emergent play mechanics.

Second order cybernetics, most notably Pask's Conversation Theory was suggested as a clear direction for how collaborative systems could incorporate the features listed within the literature. From the basic formalisms in concept entailment coherence to its ability for open collaboration and interpretation by participants. CT shows how to generate collaborative understanding through the cyclic interpretations pioneered by Pask and later developed in HCI literature (Norman 1998). These networks can then by

bootstrapped by a semi-autonomous approach to sequence generation and produce a range of narrative outcomes with clear interpretive affordances.

3. Methodology

3.1 Rationale

The following chapter develops a methodology to iterate the design of the *assimilate* system. Since the system design places emphasis on participatory narration the method looks to evaluate the participant sense-making and coherence of narrative through collaboration. This is the relevance of meaning to their own experience of the system content and to their community. Each participant approaches the experience in a unique way, dependent on the intentions they bring to the group and their relationships to one another. Each experience therefore needs to be evaluated on its own merits before conclusions can be drawn as to the design meeting some specified criteria.

The criteria in this case is centrally based around the notion of coherence. A meaningful narrative is considered coherent if the contained concepts and metaphors are made meaningful to the participants in the shared experience. In other words, if those metaphors fit to the belief shared by those in the experience. This stems from a theoretical concern that each community discovers knowledge from their own construction rather than from a central idea of truth. Essentially, for any knowledge, be it conceptual or metaphorical that is realised individually or collective, it can only be understood during the time that the associated modalities with the experience were unified. This means to qualify the knowledge it requires to understand the associated experience at the time of the exchange. This is an attempt to illuminate how the participants reflect upon the experience and the actions they took in combination with the system's feedback, as well as the actions of the other participants. An ideal system design could support this cyclic interpretation (Norman 1988). A loop of action and reflection that the system feedback can incorporate by generating new concept relations. Therefore an evaluation of narrative coherence should be correlated with the ongoing process of this feedback loop. As for understanding the modalities associated with participant acts, a coherent action may be a reaction to an image, a played sound or a conversational gesture by another participant, that may allow a reflective period to manifest.

A holistic design must take into account all the varied modalities including importantly, the embodied forms of conversation and non-conversational actions such as a gestural act. The primary embodied metaphors as discussed in section 2.1, are 'embedded' within the interface design to assist in the sharing of meaning. Embodied schema are considered gestalt forms of cognition that lead to propositional concept relations that govern the more rational understanding of narrative. This is an important consideration for evaluation of a holistic design as the resultant concepts and their relations may be quantifiable, yet those metaphors of an embodied pre-conceptual nature may be only qualitatively judged. Therefore evaluation is best served through using a set of mixed methods.

In exploring the evaluation of a holistic system, there must be an appropriate methodology to understand how embodiment may influence thematic outcomes. If so, how does this enable or otherwise influence the collaboration. This leads to the question of how the data is gathered and the tools required to

understand the collaborative experience. These take the form of a reflective questions pertaining to a participant's thinking process during the experience when a particular concept or set of concepts were generated. These can be concepts that were not only formed by individuals but by other participants as well. This is conducted by an interview process to retrospectively understand the experience where visualisations of the experience are displayed for commentary. These are visualisation tools that clarify the actions of the participant during the concept synthesis, and their mental model in relation to the concepts and their fellow participants. These tools include firstly, video playback to display the actions participants took with the interface and secondly, a map of concepts that place each concept in the context of how it manifested showing its relationship to the other networked concepts.

The map is considered the new template narrative containing the result set of generated themes and their relations and their associated media elements. Conducting an interview process with both visualisation tools present, accounts for understanding the collaboration not only through the themes represented in the theme template, but the actions that took place that directed those outcomes. This data is recorded and then corroborated in a separate interview process with each participant to understand any correlated experience. Correlated data must then be evaluated with any original narrative templates that were merged in the formation of the generated template. This part of the evaluation looks to the theoretical concerns regarding narrative intelligence and the understanding of construction of new narratives and stories. The hypothesis suggests familiarity of past events and outcomes are easily recognisable and accrue over time. For the purposes of this particular work, there are considerations to the nature of themes found in the system corpus with regards to certain universals in language, morality and cultural identity. The templates events in this case are open to wide interpretation. Many themes are common to all cultures and are still relevant today in popular culture. Certain themes however, might be relevant to particular groups. This process hopes to bring an understanding as to why certain themes resonate and if so, how these may serve to construct further meaningful template relationships.

Therefore, the question is asked if the generated concepts are meaningful or in some way analogous to the associated concept in any of the base templates. If again, a meaningful correlation is made, this may suggest the generated narrative in this case could be placed into the existing corpus and made available as a base template for further community narratives. Such an assessment may not be easy to make given a context. Questions remain as to the validity or usefulness of template knowledge either in base form or otherwise generated for further use. Here the role of the community builder must rely on previous experiences of the community and the usefulness of the knowledge to engender further creative outcomes.

For the *assimilate* project, the further aim is to validate certain theoretical design considerations for the accrual of stories in templates, and wish to keep the creative possibilities open by using a wide narrative context. As a work that stands by itself, the project hopes to build a deep template corpus to understand how creative content may be generated without dictating or otherwise leading communities with preset meanings.

3.2 Evaluation Methods

3.2.1 Observation (EM1)

This basic method recorded mainly aspects with formative issues. These determined general performance with interface mechanics before and after instruction. Participants replicating actions frequently determined some experience or intuition with the interface operations. For experienced participants, actions of collaboration were recorded as well as verbal conversations of instructional nature.

3.2.2 Unstructured Interview (EM2)

The participant is asked to discuss their experience of the work. What they doing before and after some instruction was given. Firstly information regarding their intuitions of how the interface functioned. This feedback provides important design considerations for how participants understand the operations of the physical model and its systemic consistency. The interview process follows an unstructured format. This gives the flexibility to allow the participant to mention specific areas of interest without prompting. If certain aspects of interest to the evaluation are not covered, a more directed question was asked.

Questions were asked to determine the following in all interviews:

3.2.2.1 Identify goals or intentions.

Participants were asked to identify any goals or intentions with the actions they took. This identifies any specific form of engagement beyond basic play. However it also determines if play led to any emergent intentions or actions.

3.2.2.1 Level of collaborative engagement

The level of collaborative engagement covers anything from basic awareness of other participants to open engagement, such as interaction with the interface mechanics or conversation. Some understanding of general attitude towards collaboration and engagement is also determined through indirect questions.

3.2.3 Video Cued Recall - Individual Unstructured Interview (EM3)

Following the session each participant is asked to review the video footage of the experience and recall aspects of the experience and collaboration. Each participant is interviewed separately so they may talk about the collaboration for freely. Questions similar to EM2 are asked. The recall method allows participants to freely recall important periods of the experience where they felt a significant moment took place. Often structured questions are not necessary during the interview.

3.2.4 Theme Survey (EM4)

A set of themes extracted from the narrative corpus are each given to the participants. Each theme represents a keyword that may be seen on video tags and also heard through audio dialog associated with the media snippet. Participants are asked to circle any themes relevant to their experience. Statistical analysis of any correlated themes can show any direct meaning with respect to the collaborative experience.

3.3 Evaluation Process

Described here is an evaluation process using mixed methods that aims to identify meaningful collaborations with the work, *assimilate*, by capturing a rich set of narrative contexts. The requirement is to evaluate the quality of the narratives generated through the participant collaboration and additionally understand how the system design support those experiences and contributes to coherent outcomes.

The suggested method is semi-automated, therefore useful for time-based museum installations that are logistically difficult in gathering data for analysis. During the time of the exhibition many participants may engage the work, yet it's likely that only a few participant collaborations may produce any valuable results. Therefore an evaluation process should seek to capture as much data as possible to maximise the possibility for interesting collaborations to develop.

With this question of quality in mind, how does the artist/researcher identify these rich contexts during the experience and what are the circumstances behind these particular scenarios? Are they identifiable in the media generated by the participants or are they a particular view or mindset of the participants as they generate the experience? These questions related to evaluation may be answered by improved methods of quickly identifying the context surrounding such experiences.

Action research methods can be used to effectively evaluate these experiences through a process of unstructured interviews and surveys. Usually these data gathering exercises last a few days and require the artist/researcher to gather interested participants for interviews in the hope that some creative contribution might be made. Occasionally this might be the case, however valuable outcomes are considered rare given the experimental nature of the work aims, and apparent randomness of narrative context to develop, yet these may be crucial to effectively iterate the design.

Identifying interesting moments within a highly interactive collaborative interface is the general rationale of extending the method. This particular method extends the process of video cue recall (VCR) analysis that has shown to be fruitful in identifying key moments (Costello et al. 2005, Bilda et al. 2007) of

engagement especially in relationship to understanding the role that participant embodiment plays with interactive installations.

As is typical in scenarios where creative collaboration takes place, only a fraction of the generated data could be deemed of interest to the researcher or community that generates the data. Works that create an excessive amount of content would benefit from an overall organisational scheme with respect to recording and eventual analysis. This evaluation method attempts to devise an organisational form of content gathering while utilising established methodologies of VCR, along with other mixed methods for analysing the output of system creativity and identifying key moments of the collaboration.

VCR analysis can highlight interesting collaborative sessions during the time of the installation. In the case of the work in question, the narratives generated during each session are not statically developed, rather they are largely dependent on situation and context. These could be in public spaces where some time is spent while the participant learns about how the engagement works. Within the session time period, perhaps only a short amount of that is spent creating something of interest.

What follows is a description on how this evaluation process develops. Commencing how data is segmented, time-stamped and recorded, followed by the interview process, data analysis and findings.

3.3.1 Episodic Capture and Sequencing

The following setup describes a scenario involving the work in a public space with up to four participants engaging in a touch table interface. A camera is placed next to the projector that captures participants actions with the interface, the gestures they make and the verbal conversations they have with each other. (Fig. 3)



Fig. 3 video capture setup

As participants manipulate the interface in the public setting, a database stores information regarding the narrative sequences of content developed along with simultaneously captured video. As each sequence is made, a set of gestures associated with that sequence is recorded in an *episode*.

An episode is deemed by the researcher as a segment of time when gestures and sequenced content were in co-ordination during the experience. For this work, an episode is described as the duration of the sequence (from 5 to 30 seconds) and played out on the interface along with the gestural manipulations performed by the participant. As each narrative sequence is generated, the data is passed to a server and a video segment is captured, time-stamped and named according to the current session. All associated media with each sequence is also recorded. There are numerous advantages to capturing in episodic format, mainly that of an organisational structure to allow for eventual categorisation of gestures. Additionally it allows participants to quickly identify when significant changes are made within the content and their associated gestures during the follow up interview.

3.3.2 Participant Interview and Reflection

Following the session, participants are invited to participate in viewing what they have created after the experience. An area is set aside within the installation area, or in the case of a public work, museum attendants direct participants to a separate space with a computer terminal or tablet where they can reflect upon their experiences.

Participants are presented with a web browser interface that shows the video capture of episodes on the left and the associated narrative sequence generated on the right (Fig. 4). The system has automatically generated a session code that identifies all narrative sequences generated, such that each participant can immediately start viewing the content.

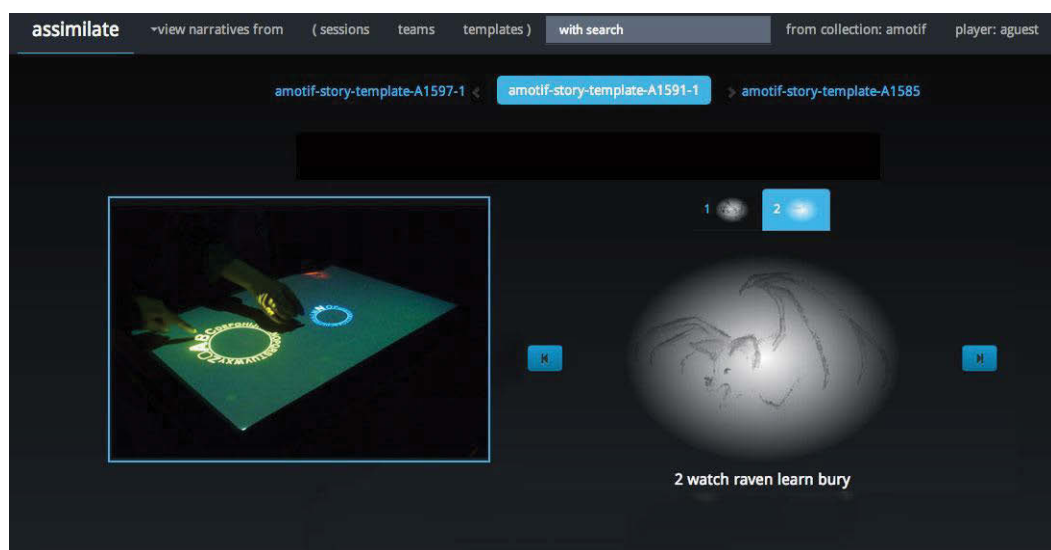


Fig. 4 session evaluation

The evaluation system has already paired each narrative sequence with the video segment in question, allowing the participant or researcher to quickly scroll through recalled content that contains less potential collaborative insights and arrive at more interesting segments.

A website page specific to the participant session has a list of the narrative sequences along with questions that are asked in an unstructured or semi-structured way. The general aim is keeping the interview process unstructured and one of the main advantages to having a web interface is allowing participants to direct their own interests (Fig. 5). The participant can simply be asked to freely scroll through the content until something during the experience takes their interest. If the participant is somewhat reluctant to verbalise their thoughts, some structured prompting can assist that process.

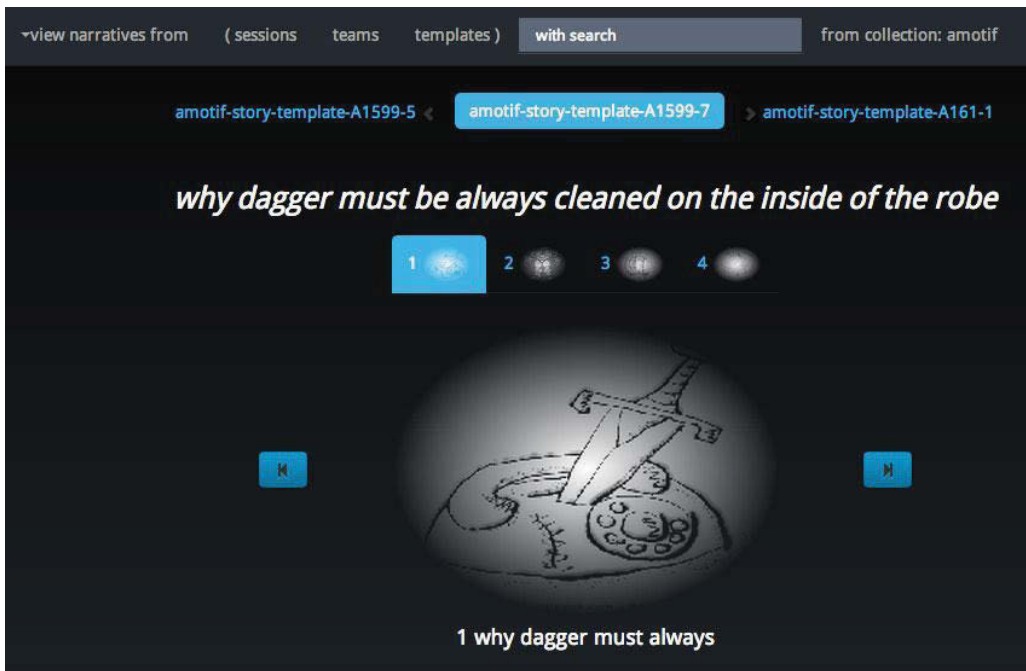


Fig. 5 narrative content

For example a participant is asked to reflect upon what they were doing, or if the aims are to understand more of the collaboration, they are asked to describe what others were doing at that time. This may give some insight into the perception of other participant experiences.

In keeping with the design aims, such that the interface itself should assist the conversation and construction of the narrative process, further structure in the interview can be made. Participants are asked why they took certain actions with the interface so aspects of gesture and behaviour can be verified. For instance, why they performed a interface gesture such as enlargement or content removal. These gestures are then compared to the participant intention to understand if these supported the narrative coherence. Furthermore, were these gestures in some way subverted or modified by the actions of others. In other words, did the actions of others in some way modify the original intention. From the perspective

of the participant this may be perceived to be unintended, yet as discussed above, this type of breach or interference of intention is a common phenomenon of narrative coherence and comprehension.

Given that one participant can only be interviewed at the time, the others can be reviewing content, filling in theme surveys, or if they so wish, record their own thoughts with or without the complete supervision of the researcher.

3.3.3 Theme Survey and Rating

The system retains an entire set of themes and narrative sequences presented with a numerical rating (a fitness) during the participant session. These ratings come from databases that the system uses to develop clustered semantic relationships between themes. Themes that are presented by system can support the creative outcomes and serve as a basis to understand the involvement of the system in facilitating narrative context.

Following this, the participant may then open a frame on the interface that reveals a set of themes in its entirety recorded during this episode. From here they can select and rate themes they thought were applicable to their experience.

3.3.4 Data Analysis and Organisation

The data examination can involve a laborious process of transcribing and organising data along with all other methods used during the interview. Capturing in episodic format allows for an organisational scheme for data capture and analysis. In terms of understanding collaboration, this process is increased by the amount participants as each with their own reflection or point of view.

Typically a group session may only last 15 minutes. If each participant generates around 20 narrative sequences per 15 minute session, that adds up to be 80 narratives throughout each collaborative experience. Furthermore each participant has a recall session for not only their own stories but potentially the narratives of others given that certain collaborations have taken place in the generation of shared narratives. Each session would therefore contain a maximum of 320 recalled experiences for each 15 minute session.

Recalling every single narrative experience in the collaboration would be a pointless exercise as it leads to cherry picking or ignoring potentially interesting scenarios that may involve further scrutiny. Such a scenario would call for more organisation with data and categorisation of video content.

The evaluation web interface can provide an organisational means to gather data into schemes and groups. Participants are able to record their thoughts regarding an experience through web player as it

relates directly to episode under review. This directs the participants attention to the experience at that time of episode capture and keeps the response generally relevant to what they are viewing.

Obviously if several participants have shown strong interest in a particular episode over others, this is generally a clear indication that transcribing is worthwhile. Although this might not always be the case, transcribing these episodes first can then lead on to further scrutiny of others.

With a combination of session episodic capture with follow up unstructured interviews and theme survey, interesting experiences involving the collaboration can be quickly identified. In many cases during the interview, the recalled experience should direct the researcher towards the episodes of interest, so they can further scrutinised. For example, if one participant forms interest into one episode, this could be corroborated another participant in a separate interview. Although both participants in this case have separate viewpoints, shared meanings and themes can be identified and *triangulated*.

3.3.5 Triangulation and Verification

For evaluation involving mixed methods, it is common to make comparisons between data sets to determine if certain themes or findings can be 'verified' or triangulated. In the case of narrative research, the triangulation process is arbitrary, in other words, the truth behind such experiences is made rather than stated absolute.

Comparing quantitative data, in this case a thematic rating, and a qualitative data, interview feedback, can make interesting comparisons that may show how a system design did in fact support eventual narrative coherence.

Throughout the evaluation process several thematic types have been identified:

- Themes rated by the system (and/or participants), these can be through narrative templates or internet search results.
- Themes developed through an interview process (concepts, events and outcomes).
- Themes categorised through comparing interviews, that show common themes identified by two or more participants within the same session.

Ideally we are looking for themes that best show a collaboration has taken place with the system in some way supporting the process. By drawing analogies between themes from system ratings to themes compared from interviews we can develop a more considered view of a narrative context.

3.3.6 Reflection and Practice

In this final stage, the practitioner assesses the evaluation data, and based on their experience and importantly their initial criteria for the work, system or community, makes a judgement on the quality of its contribution.

Questions surrounding context and situation can be asked. For example, does this creative contribution add value to a community? Or perhaps one participant reports issues with the interface due to the interference of another participant, does this mean that narrative outcome was still of value? Maybe a dramatic turn in the narrative actually created more interest in this instance?

The idea of reflective practice (Schön 1983) where the practitioner develops certain intuitions regarding the feasibility of the design and their practice. This assessment of value has generally no absolute guidelines other than the practitioner developing a critical view of their own thinking and assumptions partly based on intuition, past experience and theory.

3.4 Discussion

The evaluation methods and processes outlayed in this chapter are selected to understand the complexity of context surrounding the work. It is noted that it can never be possible to fully understand a group conversational context and true understanding of participant intention, as some of these aspects such as those embodied can often be instinctual and separate from mental thoughts. Nor should it be necessary to fully understand this context to contribute to creative collaboration.

Interviews that favour a recollection of actions during the experience can allow participants to reflect more upon their actions, if only to point out the mystery behind certain events. Ideally the aim of the method is capture the time when participants are making a combination of conscious and unconscious actions, this tends to be when the interesting moments take place. Furthermore, the researcher and participant is allowed to freely scroll through elements of interest to identify active episodes. In general this allowed for further analysis of highlighted episodes where design feature commonalities were identified.

In the proceeding results chapter, each participant is interviewed separately to assess their understanding of the collaboration. This method facilitates an understanding of participant attitudes to the session, as they felt they could speak more freely about their collaborators. Some structure was developed during this process to understand if the participant had any direct goals separate to the collaboration. More often it is assumed that goals, while they may be openly stated, were constantly modified through collaboration as was embedded into the interface mechanics themselves.

Once interviews and the recall session have been done, a further understanding of system interaction may be understood through the theme survey. Theme surveys in general were not considered as a good example of true collaboration, only a view of what system concepts were generated. In general, context was best interpreted and developed through collaboration.

4. A Collaborative System for Narrative Construction, *assimilate*

This chapter outlines the work concerning the iterative development of a system of collaborative narrative construction, *assimilate*. A work that builds upon a communal set of narratives that are seeded from mythology and folklore. It also serves as a prototype for evaluating a reusable software architecture for similar works that involve collective knowledge accumulation and reflection. The technical aim is that of a holistic architecture, or a system that enables active engagement in the emergence of meaningful collaborative narrative. These are systems that amplify or extend knowledge based on its historical relationship to the environment, where the role of the participant is integral to the systems feedback and maintenance of its own self-organised behaviour.

With this work participants engage with a multi-touch surface, gestural device or other natural user interface (NUI) that integrates into a visual collaborative environment. The interface is designed to aid in collaboration by responding to actions concerning the sequencing of narrative in an abstract virtual space. The experience is seeded by the entry of a keyword into a *ringed* space (Fig. 6) that is representative of a theme or idea participants' wish to bring to the collaboration, or a touch in the case of a predefined corpus (Fig. 7). Media such as text, image, sound and video, are displayed as representations of the narrative events, characters or themes. These are drawn from online search databases or a specified film corpus that act as template knowledge. Templates are the result of a previous successful collaborative outcomes, or in the case of this particular work initially constructed from a folklore database or existing corpus. Their function is to initiate new collaborative narratives based on existing themes. These are subsequently evaluated and added to the template corpus if considered as meaningful to the community.



Fig. 6 keyword entry

review of theoretical concerns relevant to the design and finally a complete description of the system design.

4.1 System Overview

assimilate consists of three levels (tiers) (Fig. 8) that are constructed in a networked architecture. They are a database containing a set of base template knowledge or pre-existing agreements, a self-organising application that merges gathered data from internet search results or local media corpus, and a user interface that enables interaction and renders the narratives.

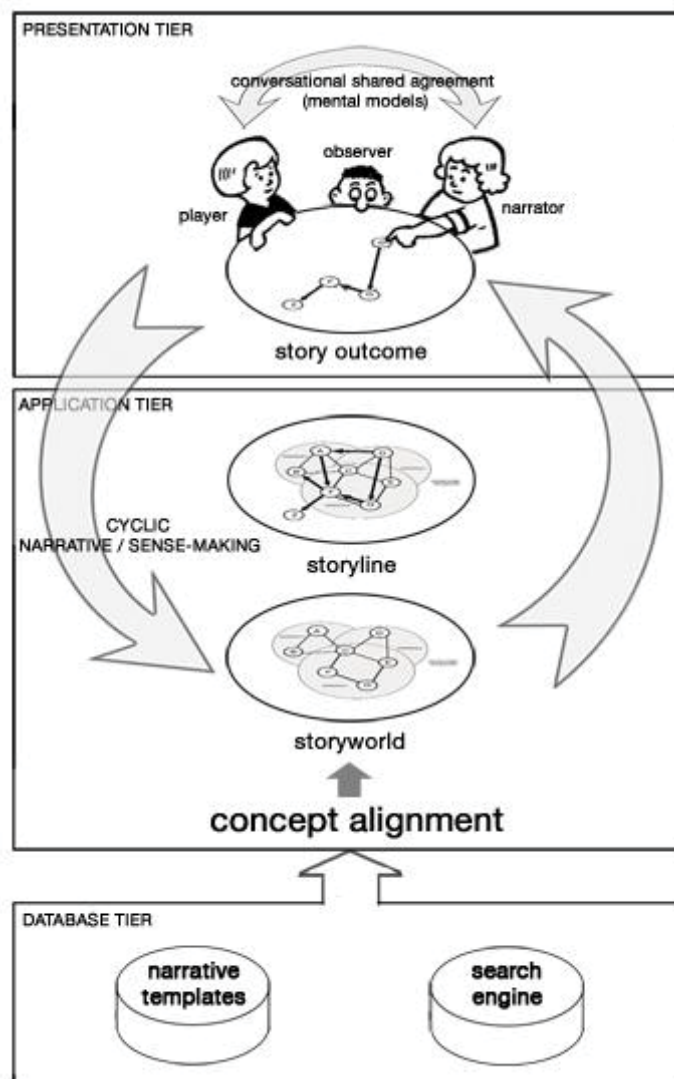


Fig. 8 tiered architecture

The work contains all the features necessary to begin a process of generative knowledge accumulation through engaging experiences. Particular choices are made with regards its seeded content or canonical knowledge, a corpus of myth and folklore (Thompson 1997) or media that contains universal themes. This knowledge domain encompasses a wide range of common sense with minimal depth, such that

commonalities in various story events can assist in constructing appropriate contexts. While it is a work itself, its architecture may also count as a research tool to understand the potential for re-use in other works.

4.1.1 Interface (1st Tier)

The interface tier consists of a multi-participatory touch-table that manages a collaborative environment and allows participants to visually construct narratives in an abstract virtual space. This renders visible the most salient narrative structures assembled from the database tier as organised by the application. A participant begins the experience by entering a keyword search or touching the space. This generates a ringed space, that expands and contracts according to the number of results that are found. The ring itself is a physical model with malleable properties that responds to gesture. It's aim is to support the intentional aspects of its participants, where gestural acts drive the experience and support conversational aspects associated with non-verbal action. Situated actions, including conversation in verbal and non-verbal form, allow participants to refine and maintain control of narrative events and outcomes on an episodic basis.

As the system is collaborative, elements of each participant's experience can also be modified by others. The variation of narrative outcome is developed as control is passed to each participant in a cyclic manner. When viewed as a holistic system with creative engagement, we see the potential for intentional aspects to be supported by the actions of the participants allowing them to switch roles dynamically between *narrator*, *player* and *observer*, while maintaining a visual coherent experience.

4.1.2 Application (2nd Tier)

The application tier consists of two layers, firstly the *Storyworld* constructed as set of participant assembled themes based on the CT entailment model (Pask 1976) and secondly the *Storyline*, that shows the possible procedural events within those themes. The *Storyworld* concepts are the narrative themes that are assembled by participants selected from narrative templates and arranged into collections of themes that make up the contextual relationships and contain common or logically inferred relationships. These are known as entailment structures. The main advantage of the entailment structure is its ability to form coherence. Its conceptual interdependence is based on its relationship to at least two others. A coherent entailment network is considered cyclic in its dependency as it is possible to procedurally shift between conceptual arrangements. The cyclical feature of CTs entailment networks are designed for collaborative viewpoints and allows collaborators to collectively shape the meaning and adopt varying viewpoints or perspectives. This feature is also associated with the natural conversational storytelling process. The *Storyline* is the event sequences that may take place. These are the event relationships between the assembled themes that make up the procedural content of the narrative. In Pask's CT these are defined as task structures or the operational methods by which to understand the context of the

network. These structures allow for any number of tasks and numerous ways to perform them. In this narrative model, the procedural task is translated as one possibility of several with the available themes.

4.1.3 Database (3rd Tier)

The database tier stores sets of narrative templates containing predetermined associative concept relations. They form the base relationships from which further reconfigurations and augmentations are generated by the collaborators. They are permuted into new narrative sequences by the alignment of search result content with the template concepts. Base concepts are carefully determined by the author, in this case, a selection of narratives derived from a corpus of mythology and folklore (Thompson 1997). Stories that accrue historically are easily recognisable. Canonical event sequences and outcomes may connect meaning to the concepts retrieved within the search results. For example, a template narrative about a world catastrophe, may evoke meaning within the modern climate change debate. Folklore stories are utilised in this case metaphorically and, while participants may consider them literal, they may also be understood to be allegorical or even ironic. Narrative systems that support creative outcomes can benefit from these historical narratives or universals by offering a rich set of events and relationships that appeal to existing metaphors and accrued knowledge patterns. Participants can also add further narrative constructions to the existing template database for reuse in further sessions. The base templates hold the contextual knowledge that allow further reconfigurations and augmentations by participants. Base themes are explored and extended by participants and further context groups are formed and agreed upon. This forms a significant basis of how the community in question develops. Evaluation of this corpus requires an holistic understanding of the experiential process of knowledge creation that only a wide range of methods can provide.

4.2. Theoretical Design Requirements of a Holistic Architecture

4.2.1 The *assimilate* Interface

The *assimilate* interface is a component part of a collaborative storytelling system (Hills 2009) that aims for narrative coherence in situated collaborative contexts. The interface is considered as a natural user interface (NUI) that manages a collaborative environment and allows participants to visually construct narratives in an abstract virtual space using various sources of online content or local video corpus (Fig. 9). The interface is an essential part of a storytelling system architecture that aligns participant themes from keyword search terms, with template narrative themes drawn from a database of mythology and folklore (Thompson 1997). This is done through a collaborative process of self-organisation based on Conversation Theory (CT) (Pask 1976), a generalised model of conversation and thematic sense-making. The following is a description of the interface and how it generates narrative coherence through amplifying the storytelling process involved during a group conversation.



Fig. 10 *assimilate* non-verbal intention.

The general approach to the interface and its incorporation into the narrative system architecture, looks to holistic paradigms of information retrieval and exchange. The interface should provide expressive affordances that expose the system's processes (Wardrip-Fruin 2007), and open them to interpretation through collaboration. These affordances consist of embedded metaphorical schemes that enhance narrative comprehension in the minds of the participants, allowing them to dynamically switch roles as narrator or participant. Common gestures associated with storytelling are mapped to interface mechanics and help to reflect participant intention. Participants create 'rings' or spaces in the content area that represent a *point-of-view* (Fig. 11). These views scale or merge together purposely or inadvertently to generate dramatic or unexpected outcomes.



Fig. 11 narrative *point-of-view*.

The primary goal of the system is to generate narrative knowledge structures through collaboration. This is knowledge that is generated through enaction or the primary bodily actions associated with the direct experiential world. In the context of the system description the following describes various aspects of design related to the collaborative interface that supports natural interaction. This includes our requirements to promote social experiences, generate and accrue meaning for a community and record those knowledge outcomes.

The following will present an overview of the interface mechanics and how embedded metaphorical schemes convey intention with the conversational process. This is followed by a brief overview of the narrative system with a focus on how the interface integrates with the system processes, and finally a discussion on the general design criteria for holistic tools that support the generation of meaning for collaborative narrative construction.

4.2.1.1 *assimilate* Interface - Description

The interface ring contains a physics model that responds to gesture inadvertent or intended, and allows for each participant to form a viewpoint by the creation of their own ring that resizes depending on the amount of visible media. Each participant controls a ringed space that is representative of a sequence or set of concepts that participants wish to bring to the collaboration. Media such as text, image, sound and video, are displayed as representations of the narrative events, characters or themes. These are drawn from online search of databases or pre-defined within a corpus, such as a series of segments from a linear based film.

The interface ring expands or contracts dependent on the amount of media elements present. Elements are annotated with a descriptive keyword tag that offers some hints of visible context. Media tags are also seen outside the ring, and these provide the potential content dependent on their distance to the ring. Only salient media elements are visible within the ring space. Each element is animated with a set of behavioural features, such as colour, size, position and duration. Element behaviours drive the aesthetics choices the participants make as to the media they retain or eventually eject from the ring. They perform this by dragging in and out the tags to create and evolve the context, or the ring itself ejects them after sequences play out (Fig. 12). Each ring can be physically merged together and the context of the media combined, thus modifying a participant's intention or otherwise steering the narrative in an alternate or unintended direction.



Fig. 12 dragging media.

4.2.1.2 *assimilate* Interface - Metaphors for Storytelling

Embodied interaction is central to the system's relationship with its participants as it supports the role the participant wishes to enact through conversation by verbal, non-verbal or gestural means and allows for dynamic or shared narration. If we are to claim that storytelling or the act of telling through conversation originates with embodied action (Verela et al. 1991), it follows a holistic interface design must account for how we assimilate narrative into our common experiences. Actions such as a conversational gesture, may be referred to as "image schemata" (Johnson 2013) and originate from embodied experience. An interface that supports primal embodied metaphors can assist participant recognition of the acts and intentions of others with respect to the feedback generated. These primal actions often relate to our bodily relationships with the world and the physical forces associated with it. With the *assimilate* interface, a physical model is used to trigger responsive feedback that enhances the transfer of spatial schemes associated with narrative exchange.

The following spatial image schemas are identified to support the metaphors embedded into the interface mechanics:

- The *container* schema delineates what is inside the ring as coherent and salient, as opposed to outside, incoherent yet potentially relevant. Each participant ring may demonstrate some intention with the visible content.
- The *centre/periphery* schema places salience on current sequences within the ringed space by highlighting those elements above others. This also allows the participant to enact a point-of-view, essential to the narrative process in characterisation or narration.

- The *scale* schema deals with the physical size of the ring which scales according to amount of content visible. Participants may dominate narration by scaling their ring or reduce the size open to sharing or collaboration.
- The *merging* schema allows a participant ring to physically merge with another, thus merging conceptual arrangements. The merging of views may be purposeful or inadvertent through the interface physics, supporting possible dramatic outcomes.



Fig. 13 storytelling gestures

By identifying common gestures with the conversational process associated with storytelling (Fig. 13), the interface attempts to incorporate the gestures directly within its mechanics (Hills 2010). Johnson's image schemas such as *container*, *centre/periphery* and *scale* are all correlated to actions with the interface ring. These embedded interface schemas seek to extend the space of meaning through visibility of non-verbal action with the output of the interface. The interface extends the metaphoric space into the collective participant space allowing narrative relationships to become more accessible and recognisable (Fig. 14).



Fig. 14 narrative recognition

As a creativity support system the interface mechanics refine the endless possibilities with search content into salient iconic representations. This allows participants to individually and collectively take particular views or perspectives with narrative content, or narration using their embodied or natural acts. These schemas are designed to correlate natural or intuitive actions associated with storytelling and narrative exchange. These embodied gestural metaphors are primary and presuppose all other forms of cognition.

Embodied metaphor schemes support collaboration by allowing non-verbal gestures to be instantly recognisable and more accessible by others. For the system design, they connect the embodied intentions of the participants with the symbolism of the content explored with each narrative generated. Within this view, the system design is seen to be a holistic method of generating knowledge.

4.2.1.3 *assimilate* Interface - Conversation

The strengths of a natural user interface (NUI) design lie in the choices participants make to interact with the system. They can accommodate a broad range of participant groups under differing circumstances. With enactive interfaces, narrative exchange supports greater engagement with the system and more importantly with other participants. Social knowledge is seen as something that emerges in meaningful collaborative outcomes and not through individual acts necessarily, rather it develops as an intersubjective process of thought and action combined through community and group conversation. It is the social conversation that drives the meaningful possibilities, and the system supports conversation by modelling the processes involved during a group conversation. This system can be known as a 'conversational information system' (N. Ford 2005), or that supports the situated action associated with conversation in the generation of knowledge. Through the enactment of conversation, participants can

form a shared agreement surrounding several themes and reach a shared understanding. We see narrative meaning as a process generated through collaborative engagement from not only through the interface itself, but through playful enactment with other participants. This evolves a shared language beyond symbolic representation where knowledge is tacitly understood. This generates consensual viewpoints formally agreed upon and must be representative of all collective views, from individuals to groups. Meaningful accrual of narrative content is seen as the generation of knowledge through holistic means.

4.2.1.4 *assimilate* Interface - Community

As already outlined, the knowledge is founded in action, that is the actions of the interface is recorded and reused for further elaborations and narrative sequences. In this sense narrative knowledge is ‘accrued’ over time as has been understood by psychologists (Bruner 1986). This historical feature of narrative may be considered an important design of interface systems that wish to accrue knowledge through community involvement.

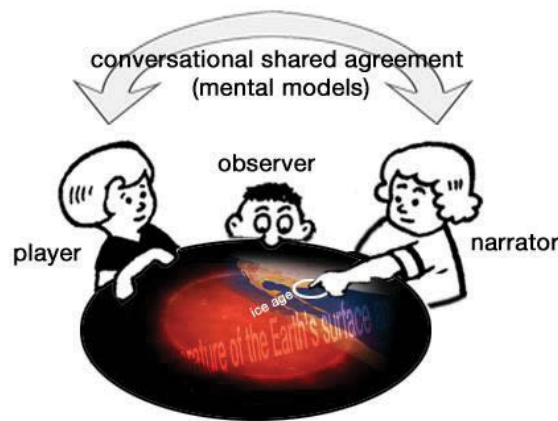


Fig. 15 conversational agreement

Essentially, participants form an agreement surrounding themes and reach a mutual understanding (Fig. 15). By the act of conversation, verbal and nonverbal, mental models of narrative may be formed and shared. These narratives may then be separated into themes, events and outcomes to represent meaningful knowledge relationships. In this case, cybernetic theories of knowledge representation have been adapted to record and represent the knowledge for reuse. Conversation Theory (Pask 1975) is a theory of social interaction, that demonstrates how to maintain narrative coherence within assembled themes, while taking into account the collective viewpoint and interpretation. Placing group conversation as central to its process, it outlines a formal method of conversational representation and is adapted here for narrative accrual and generation. Unlike traditional forms of semantic representation, it carries no formal hierarchies of knowledge, and is generated directly through active means. As a sense-making representation of knowledge relationships it allows for a negotiation of shared agreement. It can be understood in varying ways given differing perspectives surrounding several interrelated themes.

Within the theory these relationships are known as ‘entailment networks’ (Pask 1976). The essential property is that of ‘cyclicity’ or multiple entry points for participants to comprehend the relationships. This embeds interrelated knowledge, such that each concept that can be explained or understood by its relationship to at least two others (Fig. 16). This provides a rich set of possible narrative structures within the entailment structure, while remaining flexible and domain independent that is suitable to collaboration.

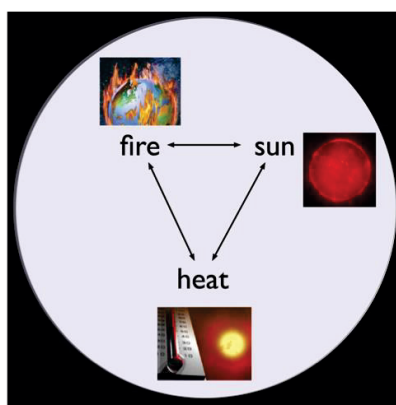


Fig. 16 cyclic entailment relationship

The basis of narrative knowledge representation within the system is based on these entailment networks. It is shown how semantic knowledge representation can work with multimodal interface to ‘enact’ new representations by the recording of the actions and relationships generated through the interface. As the knowledge is generated through embodied action, it may be considered to be amplified beyond simple symbolic representations. Finally if evaluated as meaningful, it can be added to the corpus of narratives already available to the interface.

4.2.1.5 *assimilate* Interface - Discussion

The interface design and its integration into the holistic storytelling design places emphasis on metaphor as the basis of narrative accrual in the conversational process. Metaphor is essential to the storytelling process, and arguably a pervasive aspect of communication, however also found in primal embodied actions. An interface design that supports metaphor must begin with embodied action before any other external conceptual representation can occur. This assists with participant recognition of intention, enhancing meanings by the visibility of gestural actions through interface feedback. This feedback should have an expressive appeal that renders visible its inner processes, allowing the conversational relationships modelled in the narrative templates open to interpretation yet easily procedurally recognisable.

This section has demonstrated an interface design for collaborative narrative that adopts a certain epistemological view of knowledge generation (Von Glasersfeld 1996). This is a holistic system that aims for maximising the creative possibilities by modelling a wide narrative context. The criteria for

evaluating this design should come from a qualitative understanding of participant experience, as each would approach the collaboration in a unique way dependent on the intentions they bring to the group and their relationships to one another. Such evaluation studies would point to a set of general design requirements for interfaces that generate narrative content with semi-automated systems.

4.2.2 Narrative in Community

The emergence of social knowledge is not an individual act but the outcome of a process of agreement. Communities often originate from a set of agreements or common concerns. These are shared values that seed community interest and may be considered the fundamentals of a shared language and culture. This evolves consensual knowledge representative of collective views from individuals to groups.

Creativity support systems that wish to support this epistemology (Foerster 1981) must look to the phenomenon of community narrative construction to formulate a set of general design requirements. Such designs can be considered holistic, as the active participant formulates knowledge on the basis of engagement or the notion of 'coupling' to its environment (Mataruna & Varela 1980). In the *assimilate* project, the embodied action associated with conversation in verbal and non-verbal form is central to narrative exchange, and the process by which further knowledge is extended by communal agreement. Its value is measured upon the meaningful accrual of narrative content and the generation of that knowledge through holistic means.

The work aims to incorporate participants' creative intentionality by responding to those intentions without loss of coherent meaning. This requires some understanding of the process for narrative induction into communities. The assumption is that the enactment of narrative, or the act of the telling through conversation, is the means by which stories are formed and shared. Essentially, any new knowledge we gain is a result of accrued metaphors from any existing knowledge originating from our affective experiences. This explicates the origins of narrative as an inductive process drawn directly from events and outcomes from our experiential life. If our stories originate with our embodied actions, a holistic design must account for how we *assimilate* narrative into our common experiences.

It's the induction process that forms an understanding of the experiential world, where our thoughts are organised into a 'folk psychology'; an accrued set of canonical meanings that are extended by the stories we exchange (Bruner 1990). Known as the narrative intelligence hypothesis (Bruner 1986) this states historically, we recognise familiar patterns of events and outcomes in stories and these canonically accrue meaning over time. This recognition provides criteria for system design with the possibility of aligning familiar narrative themes with participant intention. However as is common to stories, cultural familiarity is often transformed by an unexpected event or outcome. This is a communal sense-making process where belonging to a shared social environment aids the balance between the canonical and unexpected deviations.

The design of a holistic architecture that supports collaboration must generate an accrued set of canonical meanings that may be extended through consensus, intended or otherwise. A holistic system in this case, views cognition as a process that is continually externally active in the experience (Clark 2008, Hutchins 1995). The participants each externalising their own beliefs about a shared narrative experience, and having those beliefs mediated or reflected within the views of other participants. The nature of the experience supports the situated actions (Suchman 1987) with the world and emphasises the immediacy of action as most relevant to building shared understanding and trust within community engagement.

4.2.3 Conversation and Metaphor

A community knowledge system evolves coherent collaborations by modelling the supportive processes involved during group conversation. The design aims to support the situated action associated with the enactment of conversation, and facilitates participant agreement surrounding themes. Given the actions associated with conversation is the embodied form of narrative exchange, systems that incorporate metaphors to support imaginative outcomes, can support the active process of meaning generation. Since metaphor is an essential part of the storytelling process, this highlights the importance of metaphor not only in its rhetorical use in language, but also within our primary embodied actions. Metaphor in this view is a pervasive aspect of language, thought and action (Ricoeur 2003). A system design that holistically incorporates metaphor must begin with embodied action before any external conceptual representation can occur.

The following section outlines theories that describe how these natural forms of conceptual arrangement can benefit the design of collaborative systems. Firstly this section will discuss how embodied metaphors unconsciously exist in our everyday bodily movements and actions (Johnson 2013), forming a primary and gestalt form of cognition. There followed by the formation of concepts arising from these situated actions and intentions. Conceptual arrangement at this level facilitates participant agreement through the modelling of themes in a conversational form (N. Ford 2005) allowing for sense-making and agreement. This section will discuss how metaphor is embedded in the design of the interface, and how this leads to the representation of knowledge within the systems database.

Metaphor forms the structural basis of imaginative acts that are incorporated into our everyday ability to reason about experience. We may also argue that embodied metaphors are ever present patterns that cohere our experiences and lead to further metaphorical structures or new creative arrangements. This follows that the creative act is one where novelty arises from a result of such arrangements. Embodied action is arguably a foundational form of all meaningful experience and therefore of significance to the process of narrative exchange. The connection here places metaphor as the basis of the narrative accrual that is easily recognisable and shared by communities.

Systems that support primal embodied metaphors can assist participant recognition of the acts and intentions of others with respect to the feedback generated. Embedding metaphor into the interface design can support these embodied actions, and enhance the recognition of meaning or intention. Metaphor in this case binds the meaning making in the minds of the participants through visibility of those verbal and nonverbal actions, and the visible output of the interface. The interface extends the metaphoric space into the collective participant space and becomes more accessible to them and others. This is done through identifying the common patterns associated with embodied metaphors and mapping this to the actions and feedback of the interface. These patterns may be referred to as image schemata and originate from our bodily actions and experiences. They are preconceptual in our unconscious actions, yet precede the rational process of conceptual formation and allow such arrangements to take place.

Image schemata relate to the relationship of our bodily position in the world, and are largely spatialised in nature. For example, the three-dimensional elements of a contained space, and the separation of that space, namely what is inside or outside its boundaries. These concern the physical forces associated with that space, acting in balance with attraction or repulsion. They are some of the metaphorical mappings that are fused within the design of the interface, in an attempt to offload part of cognitive load of the physical space with the mental.

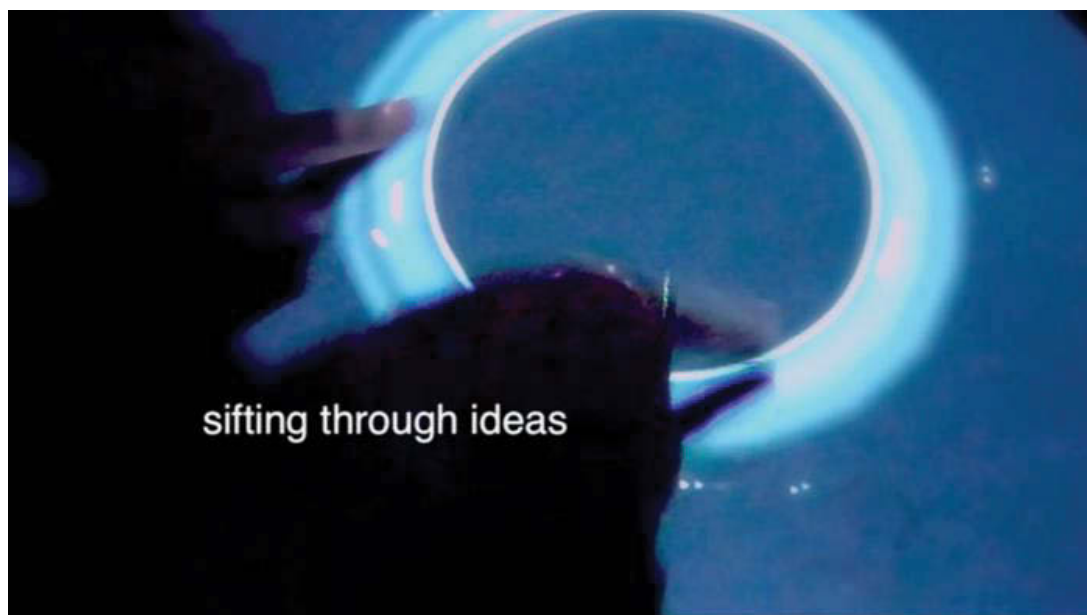


Fig. 17 embedded schemas

For *assimilate*, a natural user interface (NUI) is used to trigger a physically responsive model that may enhance the transfer of metaphorical meanings. The embedded interface schemas (Fig. 17) mentioned here are designed to assist in conveying participant intention and are key to modelling phenomena of human intention with respect to narrative exchange. These are viewed as the underlying embodied metaphors that direct the conceptual arrangements that we associate more with our reasoning faculties.

Conceptual relationships such as analogy, entailment and categorisation can be considered the result of our reasoned imagination, yet are initially directed by the intentions and actions associated with primal embodied metaphor. The embedded interface metaphors support the creation of one or more coherent spaces that focalise conceptual meanings and allow a direction of narrative sequences to form from a network of incoherent patterns. This focuses on gathering a set of themes where further agreement and consensus is made through conversational representation and agreement. How these representations are generated must be carefully considered to meet the fundamental design aim of narrative coherence generation. They must remain open and flexible while allowing for wide scope of meanings without dictating outcomes.

Rather than a causal chain of events, this is viewed as more of a cyclic feedback loop and a continual active experience. In that, meanings and relationships between concepts may be revisited and clarified. Situated action with the enactment of conversation cycles through meanings until participants reach a shared understanding in the themes assembled. With this holistic view in mind, some formal conceptual relationships are presented to initially seed further generated meanings. For this Pask's Conversation Theory (CT) (Pask 1976) is used as representative of conversational themes and relationships initially found within the template narratives. Developed by cybernetician Gordon Pask as a general learning theory, CT places conversation as central to its process and outlines a formal method of conversation that may be shared. Conversation is defined as a sense-making process or a negotiation of shared agreement given differing perspectives surrounding several topics. This defines conversation based on two distinct levels, description of knowing 'why' (cognitive or conceptual) and knowing 'how' (procedural or performative) (Pask 1975). It is this distinction that allows it to create an adaptable system that is open to collective viewpoint and interpretation. Its suitability to the design requirements are supported by the inherent self-organising principles, since conceptual relationships are generated through consensual agreement. This refers to the ability to cycle through themes forming coherence and leading to eventual action or procedures that clarify the context. This draws upon the communal properties associated with CT by incorporating many points of view in an open and coherent way.

The generation of community knowledge through an embodied conversational system based on CT formalisms, provides the conceptual metaphors that drive the cyclic process of action and reflection. When understood as a feedback process, a holistic design sets cyclic processes as central to the formation of coherence, with metaphor binding the consensus of meaning. The intent with Pask's CT is to understand this process within a constructivist epistemology (Glaserfeld 1995) in which the viability of knowledge is evaluated through corroboration and consensus, and yet is also a generalised model for representing the structure of conversational themes.

4.2.4 Understanding Narrative Context

With the process of narrative construction, either developed individually or collaboratively the context, be it environment, culture or circumstance is an important aspect in narrative comprehension. Without

context, narrative is simply a set of events without shape or meaning beyond its temporal ordering. It can originate from a number of sources - culture, human sense-making, personal identity or regular day-to-day conversation. Given the importance of context in narrative understanding, designers of creativity support systems must develop strategies that assist in meaning generation if they aim to develop meaningful community engagement.

Any evaluation of a system of narrative support must firstly acknowledge the issue of faithfully capturing rich context before assessing the creative output and meaning to its participants. The purpose in capturing this context is to allow for a system to properly display and reflect the intentions of participants as they collaborate and create shared meanings. Moreover, it allows for a comprehensive assessment of value a narrative has for a community of participants that may wish to reuse such a story in future scenarios.

Within research of narrative a general distinction is made, that being event-centred (focus on cause and effect) and experience-centred (culture, situation and context). With regards to the system design and evaluation of the project under discussion, we may refer to aspects of both. Since we require firstly, an event representation as a formal method to record narrative (a database for example), and additionally, a way to show as much contextual meaning as the narrative experience unfolds. The latter being of most importance so as to capture the context in the best holistic sense possible, that is, generating enough representation to reflect the greatest meaning for the narrative community, or culture.

The following section will discuss issues with narrative context divided into two sections. Firstly a description of how narrative context develops and the important properties of narrative that are useful to the design of narrative generation systems, followed by a comprehensive outline of the evaluation process for generated narrative content, and the value of the experience to participants.

4.2.4.1 Rationale

Analysis of people telling stories brings insight for the system design of narrative creativity support. When people describe their experiences, the process of narrative construction and reflection develops in a seemingly natural way. However narrative could not be described as a process that happens during its inception, rather only after the experience with a period of recollection and reflection. Identification of narrative is not simply a recounting of sequential events but a deep reflection on the context of the situation where it developed. By a study of narrative formation and its context in culture we can draw out specific methods of design and evaluation that can benefit system support for the narrative creativity of participants.

The following section highlights several properties associated context formation and how these are applicable to narrative system support. Firstly, the process of narrative accrual and how certain stories and themes resonate and re-occur in culture. Next the process of reflection and identity that individuals

incorporate into their present experiences. Following this, an understanding of how narrative transmits as a process of conversational exchange and finally how gesture and metaphors form the fundamentals of this exchange and enrich the context.

4.2.4.2 Accrual and Extension

While the narratives we tell may seem mundane and obvious, in reality a complex process of behavioural interpretation and reconstruction is taking place between individuals. While not just interpreting the physical and verbal intentions of the storyteller, we also place emphasis on thoughts, feelings and the social context involved. The study of this phenomena is known as narrative psychology (Bruner 1991b) which looks at how people form narratives from the intentions of others, from the everyday conversations, to the conventions that are constructed culturally over time.

Bruner suggests the narratives we tell accrue into larger meta-narratives developing cultural identities for a particular community that habitually tell certain stories to one another. These narratives are said to be canonical, and easily recognisable to those with similar contexts be it cultural or situated circumstances. When a narrative is told that breaks this canon, it is seen as an unexpected circumstance creating interest and drama that ultimately extends the narrative into new a form. This extended narrative then becomes part of the meta-narrative that may be retold within differing yet familiar social contexts.

The process of narrative accrual demonstrates a narrator's ability to incorporate canonical narrative in their situated context or surrounding environment. This gives direction on how narrative system design can use canonical concepts (or narrative templates) to seed the creativity of a community of participants, and allow those extended narratives to further accrue, shaping a collective meaning.

A narrative template is considered a simple conceptual representation in a system database that can be extended or further modified and used as a basis to generate new sequences that form relevance to a particular group, community, or artistic domain. This comes from evaluating the usefulness of the templates in seeding creative ideas that resonate with the participants or the community they represent.

New narrative sequences are judged for their creative contributions and are added to the template corpus for further reuse. The basis of narrative accrual suggests that something meaningful can be reused in the narrative template corpus that may contribute value over the time of the works installation. This incorporates evaluation as part of the system design that evolves through ongoing engagement.

4.2.4.3 Context - Reflection and Identity

Narrative is said to be deeply intertwined with identity, or a sense that certain events have taken place within a particular context that requires reflection or mental organisation. (Freeman 2003) suggests our reflections come only after a delay where realisations and connections are made only after events have taken place. When reflecting upon our own stories we may refer to situations from the past (or future), while bringing those into present circumstances and context. Essentially as we enact a possible narrative, we may not know that we have contributed to one at the time of its inception.

Cognitive psychologists (Gazzaniga 1998) have developed the theory of an 'interpretive module' that recognises patterns of experience and attempts a narrative organisation that fits within our world views. If lived experience is inconsistent with those views, sections may be fictionalised or otherwise developed more towards our own sense of identity. This process of fictionalisation and identity development impacts on present context where stories are told or retold. As we develop our own narrative and sense of identity from past or future contexts we also incorporate them into newly constructed narratives in our present circumstances.

Understanding this process of identity development provides clues for how a collaborative system of narrative generation can support or direct circumstances in a particular knowledge domain. That is, seed a series of concepts that participants can identify with and extend as the collaboration develops. In this case, in similarity to a canonical narrative template, a participant or community can shape and reuse narrative concepts that have impacted on their past experiences using the system.

4.2.4.4 Conversation and Coherence

Maintaining narrative coherence is one of the main difficulties faced in interactive storytelling system design. Interactive storytelling implies some form of participant control of the system and this creates a direct conflict with coherent delivery of narrative, therefore management of this relationship remains an important factor in any design. To deal with this problem, interactive storytelling research tends to focus on techniques of plot segment delivery including systems that are rule based (Crawford 2004), goal based (Marc Cavazza et al. 2002) or those based on narrative functions constrained by a story context (M. Mateas & Stern 2003). These systems attempt to automate narration based on participant choice with moderate success, yet they remain tightly coupled to their content and thus lack adaptability to larger or generic domains.

There is an alternative strategy however, one that invites collaboration and shared narration allowing for a larger scope of generic themes in a visual storytelling context. By placing emphasis on participatory narration it assumes that narrative coherence is largely dependent on the participants themselves. This accounts for how narrative manifests in our community and the mental models we form from those

influences. It can be broadly classed as a ‘conversational information system’ (Ford 2004), or one that structures knowledge to manifest coherent collaborations by modelling the supportive processes involved during a group conversation. The system design supports the situated action (Suchman 1987) associated with oral and visual storytelling and the exchange of narrative themes. Through the enactment of conversation, participants can form a shared agreement surrounding several themes and reach a shared understanding.

Given the process of narrative development is deeply intertwined with interpretation and reflection on context, insight into its collaborative construction can be found during its enactment. Here we make the assumption that one of its primary modes of narrative development is the act of the telling through conversation, and the means by which mental models of narrative are formed and shared. To reflect upon a narrative exchange through conversation we would not only observe the language but also the situation and actions that took place to truly understand its context. The implication for design is how best to support the conversation in a holistic approach, meaning one that is truly representative of a narrative context that include aspects of not only formal representation (concepts and relationships) but also of situated context.

As discussed with narratives of cultural and identity formation, careful seeding of domain concepts resonate greater collective meaning enhancing creative development. Similarly with the representation of conversation as constructed in narrative situations, we look for flexible and extensible models of conversation that are recognised and collectively understood. Again Pask’s Conversation Theory (CT) (Pask 1976) with its roots in pedagogical theory and social communication, develops a systems theory of language modelling based from the relationships of meaning we attribute to everyday conversation surrounding topics of collective interest (see section 2.3). In this way, a domain of knowledge can be represented structurally through its relationships and allow several participants to navigate the same structure while forming their own point of view.

Conceptual relationships are dependent on at least two others within the same network. For example the concept *fire* entails both *sun* and *heat*, while the two other concepts are also related to each other in the same way. This type of relationship in CT is known as *coherent*, and these form networks of entailments that represent a body of knowledge. Coherent relationships said to be cyclic, that is, understood by shifting around the relationships in any direction. Cyclic relationships provide a rich set of possible narrative structures allowing participants to adopt their own unique perspective within the concept network.

Within this narrative system design (Hills 2010), CT’s coherent relationships form the context of the narrative (*Storyworld*) while movement around those concepts are possible procedural sequences (*Storyline*).

Collaborative sense-making is central to the process allowing for a shared conversation surrounding a particular narrative context. Although this represents a formal structure for conversation, the network is receptive to change, supporting a process that invites action to clarify context.

4.2.4.5 Metaphor and Gesture

During the enactment of conversation we participate in a collective phenomena that draws from our experiences in the world. For this reason, conversation directly relates to our embodied experiences such as the relationship of our bodily actions in the world. Although this notion might seem trivial, when we point to an object for example and name it, we are exhibiting a fundamental aspect of our cognition that is not only easily recognisable by others but also easily communicates our intention. In this sense, the gesture may be considered primal, in that it predates any other form of language. This is sense we could determine that the gesture is a primal metaphor (Johnson 2013) and all other forms of language and associated metaphors (Lakoff & Johnson 2008b) contextually related to this gesture is layered or reliant of its existence. This powerful notion with gestural metaphor has many interesting applications to systems of narrative generation in its ability to translate or support this conversational act.

4.2.4.6 Discussion on Narrative Context

The *assimilate* project conveys gestural action by embedding primal metaphorical schemes into its interface mechanics (Fig 18). With a natural user interaction (NUI) device for collaboration such as a touch table or kinect that supports multi-participatory input, each participant manages their own interface for sequencing narrative. Participants create *rings* or circular spaces in the surface area that represents a *point-of-view* or a collection of content given by the template narratives.

Each ring may then collect narrative media, (such as images, videos and text) that form narrative sequences once inside the ringed space. Sequences can be reordered or content may be removed or added to ring from *outside* to *inside* and *exchanged*. Rings can also be *enlarged* or *merged* with the other participant rings, and in this sense form dramatic or inadvertent outcomes. The embedded narrative mechanics attempt to relate its physical forces with bodily gestures to convey narrative intention. By embedding metaphorical schemes the interface incorporates participant recognition of the acts and intentions of others. From the formal conversational symbols represented by CT theory (narrative media), the interface extends the visual narrative with gestural metaphor allowing narrative relationships to become more accessible and recognisable.



Fig. 18 narrative gesture and interface mechanics

Evaluation of systems for collaborative creativity will inevitably face problems of understanding context in some form or another. A general approach is to either use a highly structured context and limit the possibilities for creativity, or unstructured giving complete freedom of possibility. While the latter seems more applicable, an unstructured approach can easily produce meaningless content. On the other hand, highly structured narratives often do not creatively extend beyond the set concept templates, nor truly involve the participants in their creation.

The specific work discussed here, *assimilate*, explores the possibilities with visual narrative generation by beginning from the extremely unstructured end of participant agency and shifting the participants towards producing coherence in the narratives they create. In many cases the participants may feel that narrative coherence is illusive and that no meaning is generated, but the possibility to generate something of value to the domain or community is greater and ultimately the design goal of the project. Inevitably though, system designers must get this balance right. They deal with a form of creative collaboration that can only be understood with some reflection after the experience itself usually performed by the researcher evaluating the statistical criteria or through surveying experiences from participants. While understanding a correlated gesture with a narrative meaning in a statistical or formative manner is typical in many HCI approaches, this in itself does not deal with the collective meanings of the situation which is essentially where the creativity 'resides'. This ultimately leads to the reflective practitioner having the final say in the design iteration.

This is an ongoing process to understand how interactive digital narrative works can progress based on collaborative participant engagement and subsequent evaluation. Through proper analysis of context along with the evaluation process described, some understanding of these complexities may be achieved.

4.2.5 Developing Emergent Play

The following section presents the application of emergent play features for the *assimilate* system. The description includes an understanding of boundaries in narrative context and fictional world construction, followed by a holistic view of player experience with emergence and how interface mechanics support this collaboration for online deployment.

The model (Hills 2010) is based on Conversation Theory (CT) (Pask 1975), a cybernetic theory of learning and social interaction, that self-organises a set thematic relationships based on group conversation with eventual agreement on the context and meanings. As is applicable to an emergent system, relationships are arranged from simple rules or formalisms that scale into larger networks of meaning and may be combined or pruned through player participation. These networks, known as entailment meshes (Pask 1976) (Fig. 19), are based on a simple formalism such that each concept is interdependent on at least two others.

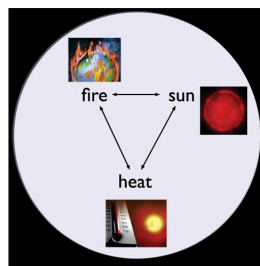


Fig. 19 CT entailment

The most fundamental mesh would consist of three concepts, with every concept drawing its meaning based on its relationship to the other two. With all three exhibiting this relationship, this is said to achieve coherence within the CT theory. Coherence in this case meaning a participant can begin with any concept in the mesh and shift procedurally through the relationships in any arbitrary direction while developing an understanding of the assembled themes. This freedom to shift within an assembled concept network provides numerous entry points or *cyclicity*, such that there are no 'dead ends' in the entailment structure. When entailment networks are scaled or merged through collaborative action this provides the flexibility in the narrative structure and allows each participant to formulate their own point of view while developing a mental model that others may share based on their own actions within the network.

4.2.5.1 Emergent Play - Interface Metaphors For Conversation

Emergent play experiences can directly benefit from collaborative experiences and the development of schemes for co-creation of artefacts within the fictional world that build community and social development. For play experiences the boundaries of context in the fictional space are embedded in the

metaphors of the interface. This extends the conversational process and shows aspects of intention surrounding the collective narrative construction (Hills 2011).

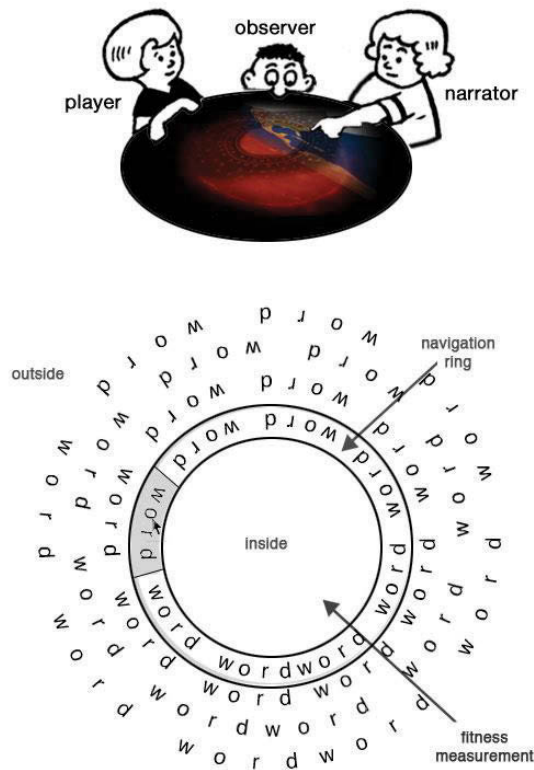


Fig. 20 fitness measurement

Interface metaphors can support narrative comprehension and fictional world coherence through reflecting actions that are recognisable by other players and through revealing features of the system’s inner processes. Each player begins the experience by opening a ‘ring’ space and typing a keyword that performs an internet search request. Retrieved video content circles the ring along with an associated annotated word tag. Salient or ‘fit’ tags (Fig. 20) are placed inside the ring and associated video content plays out within the ringed space in a sequence. Tags that are outside the ring may be selected and dragged inside forming new sequences. The ring exhibits a physics model that responds to gestural movement that can be expanded or reduced to narrow the amount of sequenced content. Furthermore, each participant’s ring can be merged with others to form new combined sequences. These interface mechanics are considered metaphors for narrative construction and maintain common recognisable aspects of conversation associated with storytelling, as such scope, exchanging views and merging ideas (Fig. 21). These are either performed intentionally or inadvertently through the mechanics or player actions to produce dramatic or unexpected outcomes, a common feature of narrative emergence.



Fig.21 rings touch and merge

The participant rings are considered as agents in the experience that attempt to incorporate participants' creative actions and also show the self-organising conversational process. This is an attempt to visualise the system process. A form of expressive processing (Wardrip-Fruin 2009) that develops the relationship between system processes and the surface level interaction of the players. This relationship is central to idea of developing emergent play as it provides affordances to the participant for enacting a conversation. In similar ways to enabling a group of improvisational actors, it exhibits clues on how actions are taking place in the fictional world and invites collaboration. This allows the participant to enact a conversation with the fictional world and assume a dynamic role of *narrator*, *player* or *observer*.

The general approach to the interface and its incorporation with the system processes, looks to holistic paradigm for how mental models and cognitive convergence can take place. While the system formalises some narrative structure through self-organisation, the interface metaphors allow for creative possibilities to emerge. The combination of the fictional world, the interface affordances and the understanding of the participant's mental model in relationship to the other participants, create the possibility for an emergence to take place.

4.2.5.2 Emergent Play - Discussion

This section has presented a view of emergent play that considers participants experience of real world knowledge to develop appropriate fictional world affordances. Our comprehension of the real world is a continual sense-making process that accumulates knowledge from the world based on our bodily relationship to the world. This takes into account a holistic view of how emergence occurs in the real world and its possible application in fictional worlds to drive narrative coherence.

A study of situated and embodied cognition can provide design clues for how participants can perceive certain affordances. One such view explains our tendency to side with simple narrative explanations for

complex emergent behaviour. However there is an inherent disconnect between the causal relationships at the emergent level, and the eventual narrative that is extracted (Walsh 2011). From this view the possibility is that layering top down approaches, such as drama management over the emergent behavioural layer (agent behaviours) only serves to replace or simplify a chaotic system of possible micro-stories rendering the system sparse of creative possibilities. One possible solution suggested in the section is an interface that invites play as an improvisational actor with shared goals that are developed by visible and real embodied action of the participants. This is facilitated by a set of clearly defined and simplified affordances that provide recognisable metaphors for collaboration.

4.3 System Framework

The aim of the framework is to support the process of collaborative narrative construction (Fig. 22). Combining aspects of our inherent narrative intelligence and the mental models we form around stories, this framework is flexible enough to incorporate a large domain of existing narrative templates containing sets of semantic and rhetorical relationships. This combines CT entailment structures where each template is mapped into Pask's cognitive distinction of declarative and procedural knowledge. The entailment nets are activated as collections of themes that contribute to the narrative in question (why), while the rhetorical relations form the procedural or possible sequences of events that can take place (how). This is represented as a graph model that bootstraps CT entailment nets, that are inherently non-directional, with a directed graph of procedural relations. Knowledge represented in entailment meshes is bootstrapped with semantic relations, these then refine the ambiguous asymmetric relations of the mesh (Heylighen 2001). The rhetorical relations offer procedural ways to navigate the context of the constructed entailment nets while the ambiguity is largely regulated by participants.

4.3.1 Conversational System

In group conversation, experienced storytellers seemingly bring together a range of situated factors with flexibility and timing. Instinctively they know how to engage their audience with empathy, while understanding differing views and narrative exchange. This section discusses a framework that incorporates shared narration through the design and evaluation of a creativity support system that promotes meaning and sense-making for collaborative storytelling in situated contexts. The approach is to develop a unified and holistic system that incorporates our cultural and historical ways of telling stories while creatively supporting new collective narratives from the many sources online.

assimilate: Collaborative Narrative Construction

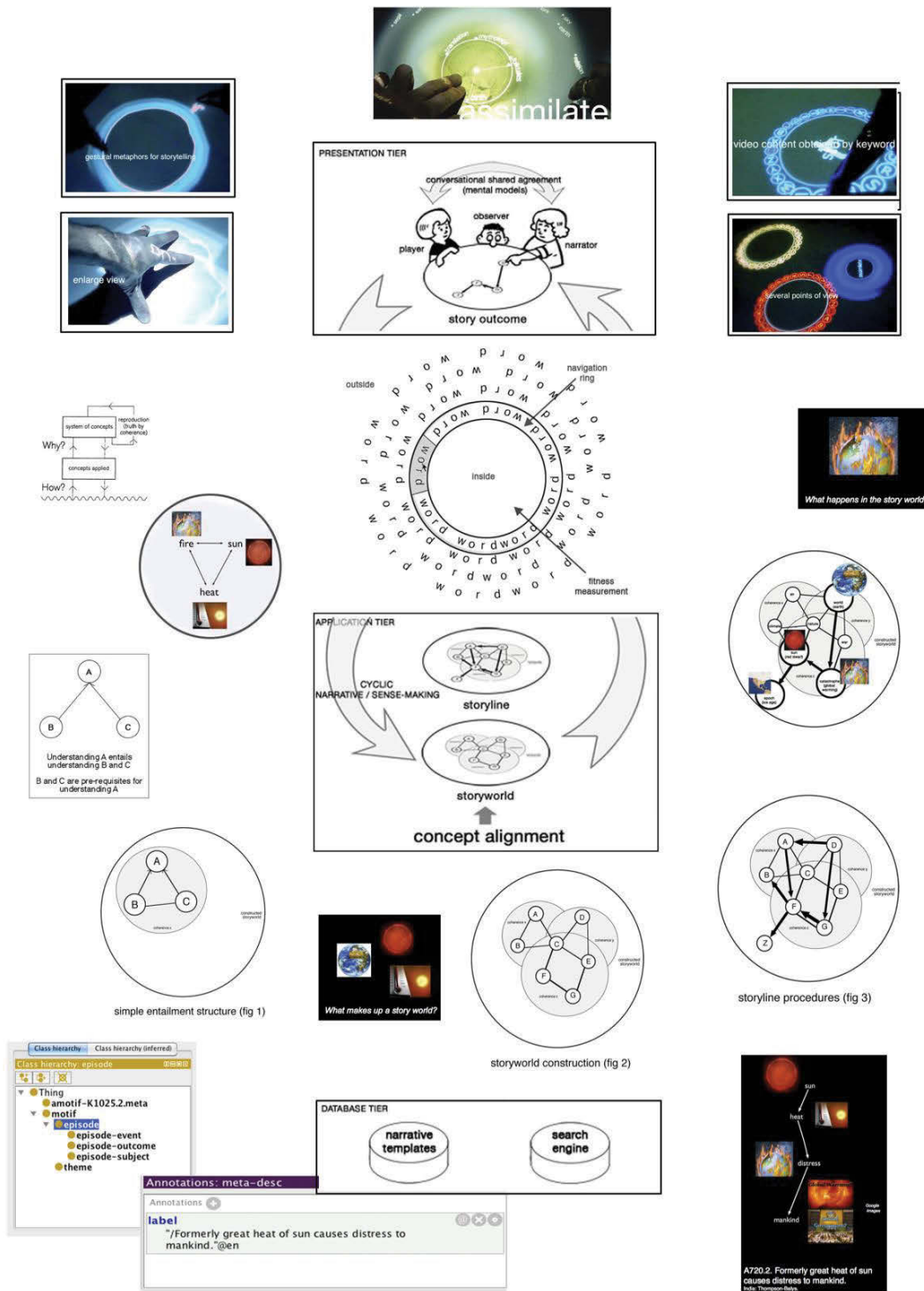


Fig.22 *assimilate* - collaborative narrative construction

This system is classed as a 'conversational information system' (N. Ford 2005), or one that structures knowledge to manifest coherent collaborations by amplifying the supportive processes during a group conversation, or in this case, the situated modalities associated with oral, tactile and visual storytelling. A

holistic storytelling architecture requires a tangible interface that supports the group role the collaborator wishes to play or enact as narrator or audience, while building upon a knowledge base of template themes that appeal to existing metaphors and accrued knowledge patterns that are extended or breached (Bruner 1990). It's through the enactment of conversation, that participants can form an agreement surrounding several themes and reach a shared understanding. The assumption is the enactment of narrative, or the act of the telling through conversation, is the means by which mental models of narrative are formed and shared, therefore support of these shared models should be the central feature of collaborative systems that seek to maintain narrative coherence.

Pask's Conversation Theory (CT) (Pask 1976), a 2nd-order cybernetic theory of learning and social interaction, can demonstrate how to maintain narrative coherence within a set of assembled themes, while taking into account the collective viewpoint and interpretation of collaborators. This places group conversation central to its process and outlines a formal method of conversation as a sense-making network or a negotiation of shared agreement given differing perspectives surrounding several interrelated themes, that lead to eventual action or procedures that clarify the context. Pask defined conversation based on two distinct levels, description of knowing 'why' (cognitive or conceptual) and knowing 'how' (procedural or performative). This cognitive distinction is useful in identifying the learning styles of participants that are classed as either 'serialist', understanding topic relationships through steps, or 'holist', taking a global approach. Both styles can be incorporated into the same network, as typically most learners used some combination of both. From a storytelling standpoint, this allows a focus with which to take a particular narrative perspective and compare that to the other participants, globally or locally within a story world. Conversation Theory coheres themed worlds by the construction of the entailment mesh. These are concept networks that embed interrelated knowledge, such that each concept that can be explained or understood by its relationship to at least two others. Such networks, known as entailment meshes (Pask 1975), are said to introduce cyclicity and achieve a conceptual coherence. Cyclicity produces multiple entry points for collaborators to understand the relationships, providing a rich set of possible narrative structures (Scott 2005) within the entailment structure, while remaining flexible and domain independent that is suitable to collaborative storytelling.

4.3.2 System Architecture - 3 Tiered

The architecture (Fig. 23) is based on a holistic design that centres on face-to-face group situations and emphasises how mental models and intentions are understood by others, and not necessarily by the system itself. With these general aims in mind, the model for story template representation should be flexible enough to allow a participant to take a particular narrative perspective and compare that to the other participants, globally or locally within a story world. This is done by modelling conversational relationships (Pask 1998) with the aim of self-organising and negotiating an agreement surrounding several themes. Conversation Theory (CT), a 2nd-order cybernetic theory of learning and social interaction, can demonstrate how to maintain narrative coherence within a set of assembled themes, while taking into account the collective viewpoint and interpretation of co-collaborators. This places group

conversation central to its process and outlines a formal method of conversation as a sense-making network or a negotiation of shared agreement surrounding several interrelated themes, that lead to eventual action or procedures that clarify the context.

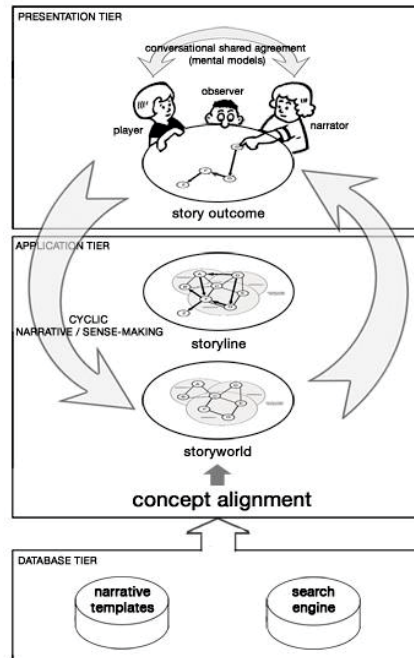


Fig. 23 3-tiered architecture

The central feature of CT is the construction of the entailment mesh (Scott 2000). These are concept networks that embed interrelated knowledge, such that each concept that can be explained or understood by its relationship to at least two others. From the theory, entailment networks are said to achieve coherence, that is, a network of localised relationships that are considered ‘operationally closed’, or cyclic, in its dependency (Fig. 24) . The advantages cyclic relationships provide a rich set of possible narrative structures within the entailment mesh. This allows participants to procedurally adopt several viewpoints or perspectives within the network.

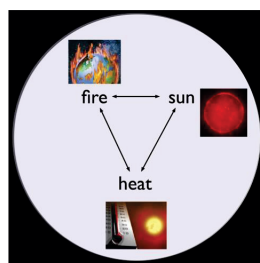


Fig. 24 cyclic dependency

The focal point of narrative coherence and viewpoint is the interface ring itself. Its role is to visualise these self-organising relationships within the 'coherent' ringed space, such that each annotated tag within the ring may be re-organised or ejected to collectively shape the network’s meaning. Participants

construct the narrative themes in this manner to form any arbitrary number of coherent networks that are assigned ratings dependent on the contextual strength of their associated theme relation. These themes are considered the fittest based on collective ratings (Fig. 25) and is a result of entailment relationships that have been retained with each conversational session.

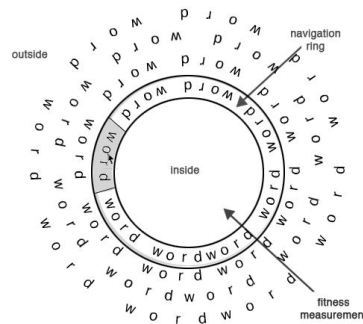


Fig. 25 collective ratings

The visualisation of narrative relationships with entailment structures, allows for a cyclic interpretation and may be suitable to a range of narrative styles in a domain independent and scalable way. The interface plays a central role in the system architecture by representing the cyclic properties of these entailments while maintaining coherence. The cyclicity inherent within the system is adaptive to collaborative input and potentially covers a range of narrative sequences and modes. The proposed framework is constructed as a multi-tiered network architecture including, the database tier containing a pre-processed set of templates with recognizable narratives, the application tier consisting of two layers, *Storyworld* and *Storyline* that models the conceptual and procedural relationships, and finally a presentation tier that allows for collaborative ratings of the given procedures.

4.3.2.1 System Tier 1 - Template Database

To support a range of creative outcomes in a visual storytelling context, the database tier contains a wide yet shallow domain of multi-representational themes with predetermined associative concept relations and CT entailment networks. These are sets of ontology templates drawn from a corpus of motifs (Thompson 1997) transformed into a story grammar to ascertain common story relations such as narrative consequences or events. Ontology templates are considered a useful technique (Broekstra et al. 2001; Tuffield et al. 2003; Ehrig & Sure 2004; Peinado & Gervas 2005, Tarau & Figa 2004) and these are typically stored as semantic web languages, OWL or RDF, for their flexibility and interoperability. However a database supporting multi-dimensional data representations (Chang et al. 2006), may be suitable to support applications that implement conversational knowledge representations (Nigel Ford 2005b). Pre-processed template concepts are semantically aligned with the themes selected by participants. The concepts can then be easily associated with others in the network and their context inferred. The context in the templates is derived from common-sense databases (Singh et al.) where contextual knowledge are representations of facts from every-day life, including relationships that are

spatial, temporal and causal. Common sense knowledge has a wide and shallow domain as opposed to expert knowledge that is deep. For this reason, it is applicable to a general storytelling corpus where typical or multi-representational themes can be assembled. Participants add to the existing templates by seeding their own narrative themes that are aligned with existing templates. Once new relationships and stories are generated, they may be added to the corpus to form new templates.

4.3.2.2 System Tier 2 - Application

The application tier consists of two layers, firstly the *Storyworld* constructed as CT entailment structures, and the *Storyline* forming the possible procedures of that world represented as event relationships. Entailment nets are activated as collections of themes that contribute to the narrative in question (why), while simple event relations form the procedural or possible sequences of events that can take place (how). This is represented as a graph model that bootstraps entailment nets, that are inherently non-directional, with a directed graph of procedural relations. Knowledge represented in entailment meshes is bootstrapped with semantic relations, these refine the ambiguous asymmetric relations of the mesh (Heylighen 2001). The event relations offer procedural ways to navigate the context while ambiguity is largely regulated or extended by group consensus.

4.3.2.2.1 Storyworld Construction

The *Storyworld* concepts are the narrative themes that are assembled by participants selected from narrative templates and arranged into CT entailment structures. Entailment networks are collections of themes that make up the contextual relationships and contain common or logically inferred relationships. In this model it is seen as the context for the story world.

Techniques of clustering and coherence checking are fundamental to participatory conversational networks. Ford (Nigel Ford 2005a) states the desire for a flexible collaborative system that allows for negotiated shared agreement. The main advantage of the entailment structure is its ability to form coherence. Given a network of three or more themes (A,B,C), the context of theme A entails the context of B and C. This simple idea shows that each theme can be explained on its relationship to at least two others, such a network is known as coherent (Fig. 26).

A coherent entailment network is considered 'operationally closed', or cyclic, in its dependency. This is advantageous for collaboration as it allows participants to adopt several viewpoints or perspectives. It also collectively shapes the network's meaning. Participants construct the narrative themes in this manner to form any arbitrary number of coherent networks that are assigned ratings dependent on the contextual strength of their associated theme relation.

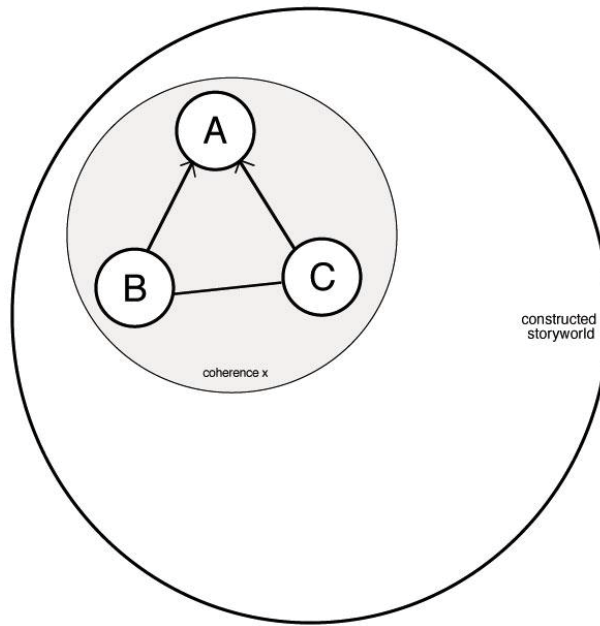


Fig. 26 entailment - *StoryWorld*

In CT, entailment networks allow for the process of pruning, or reducing, the ambiguity by merging related themes or separating them by analogy. This model allows for this process to be conducted in real time through collective participation reducing the complexity of relations, and assisting with visualisation. The construction of the *Storyworld* is a continual sense-making process where thematic ideas can be assembled collaboratively. These concepts are narrative themes that dynamically assemble through participant selection and arranged into CT entailment structures. The main advantage of the entailment structure is its ability to form ‘coherence’. Given a network of three or more themes (A,B,C), the context of theme A entails the context of B and C. This simple idea shows that each theme can be explained on its relationship to at least two others, such a network is known as coherent. CT entailment networks, story ontology templates and common sense knowledge all contribute to this process. However for the requirement of storytelling, this context alone cannot explain how the narrative manifests. This leads on to the selection of procedural ways the themes may be arranged into one or more *Storylines*.

A coherent entailment network is considered ‘operationally closed’, or cyclic, in its dependency. This is advantageous for collaboration as it allows participants to adopt several viewpoints or perspectives. It also collectively shapes the network’s meaning. Participants construct the narrative themes in this manner to form any arbitrary number of coherent networks that are assigned ratings dependent on the contextual strength of their associated theme relation (Fig. 27).

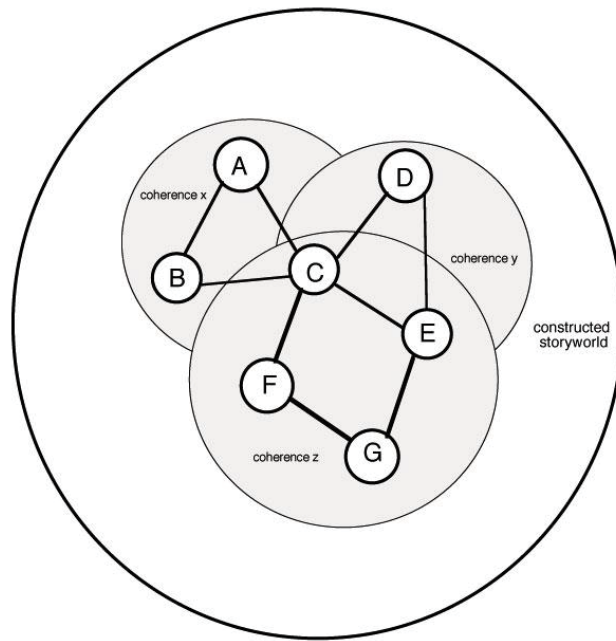


Fig. 27 coherence construction - *Storyworld*

These themes are then added to the *Storyworld* to further episodic content to the existing narrative, forming sub-plots or differing outcomes that break with the canonical. Since entailment structures are cyclic in their dependencies, narrative themes may be revisited for further elaborations or forming new storylines.

In CT, entailment networks allow for the process of pruning, or reducing, the ambiguity by merging related themes or separating them by analogy. Common sense databases (Singh et al. n.d.) contain many such analogous relationships that can associate everyday meanings with the example themes. Following CT's entailment structures, the themes contain derivable relationships are supported by at least two others, in this case 'fire' may be supported by two other themes, 'sun' and 'heat' that stem from other myths in the corpus. (Fig. 28)

4.3.2.2.2 Storyline Construction

The storyline is the possible event sequences that may take place. These are the relationships between the assembled themes in the form of RST relations and make up the procedural content of the narrative. Pask defined these procedures as task structures or the operational methods by which to understand the context of the network. The CT entailment structures allow for any number of tasks and numerous ways to perform them. In this storytelling model, the procedural task is translated as one possibility of a storyline. (Fig. 29)

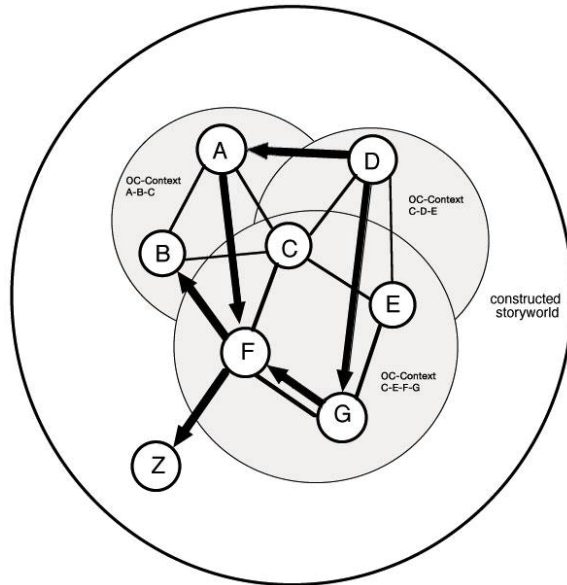


Fig. 28 entailment theme procedures - *Storyline*

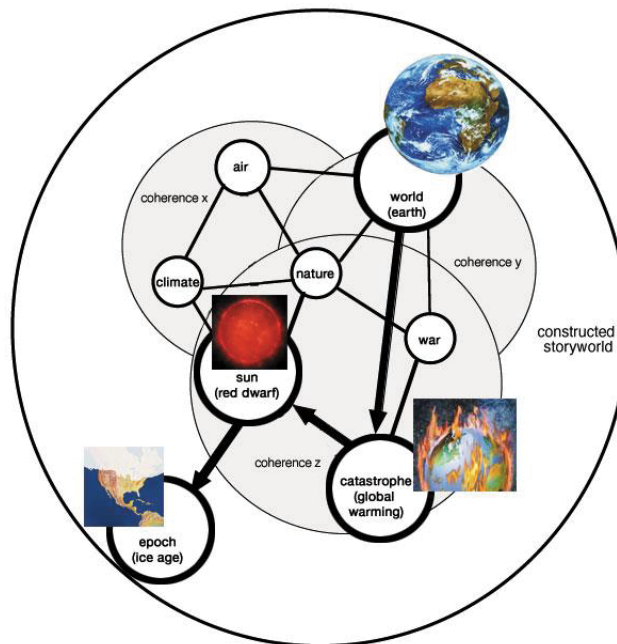


Fig. 29 construction - *Storyline*

The *Storyline* is the possible event sequences that may take place. These are the relationships between the assembled themes in the form of event relations or consequences and make up the procedural content of the narrative. Pask defined these procedures as task structures or the operational methods by which to understand the context of the network. The CT entailment structures allow for any number of tasks and numerous ways to perform them. (Fig. 30)

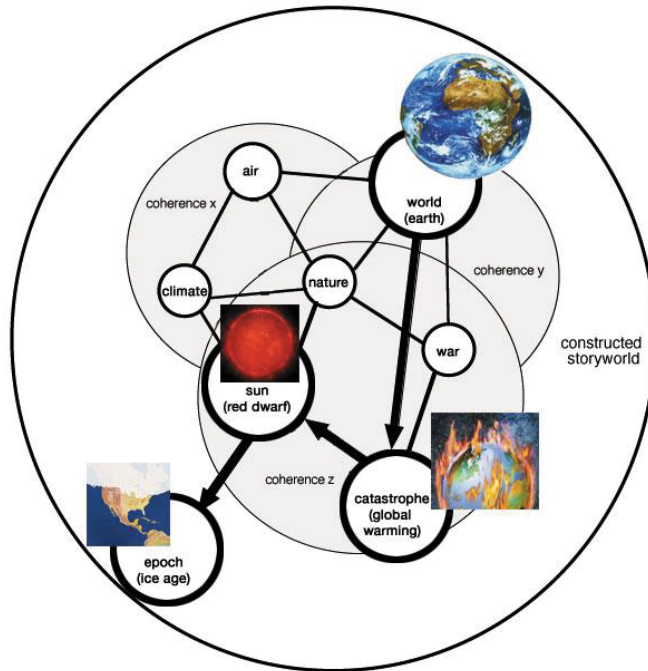


Fig. 30 procedural construction - *Storyline*

4.3.2.3 System Architecture Tier - Interface Tier

The presentation tier consists of a multi-participatory interface that facilitates the collective choice of procedural content as assembled by the application tier. The key requirements for this interface would be firstly to allow participants to seed thematic content to be aligned with the template database and placed within the *Storyworld*, and secondly to facilitate the selection of procedural events based on those assembled from the *Storyline*. The interface should also render visible the most salient narrative structures from the temple database yet cater for a broader range of narratives that may suit the thematic context. These narratives are considered the fittest based on collective ratings calculated from several metrics including, its conceptual semantic relevance, its narrative event relationships and most importantly, the relevance given by the participants.

The interface aids collaboration by reflecting the intentions of participants with the systems processes. Rendering the salient narratives also expresses the processes associated with them. This is a form of expressive processing (Wardrip-Fruin 2009) that looks at the relationship between the systems processes and the surface level interaction with the participants. This approach is central to the system's relationship with its users as it supports the role the participant wishes to play or enact through conversation by verbal, nonverbal or gestural means. Revealing those processes at the surface level allows participants to switch roles dynamically between *narrator*, *player* and *observer*. Those situated actions are also supported by the interface and system states to promote the shared outcomes and consensus.

Participants seed themes by entering a keyword that retrieves content from online sources with associated annotations. A series of templates are retrieved that are matched through semantic alignment with the

search result annotations. Collaborators are able to regulate the thematic context by selecting and removing key words while the salient narrative content is rendered visible and progresses through the procedural events associated with the narrative relationships. These narratives are considered the fittest based on collective ratings calculated from the relevance given by the participants. The focal point of narrative fitness and viewpoint is the navigation ring. (Fig. 31)

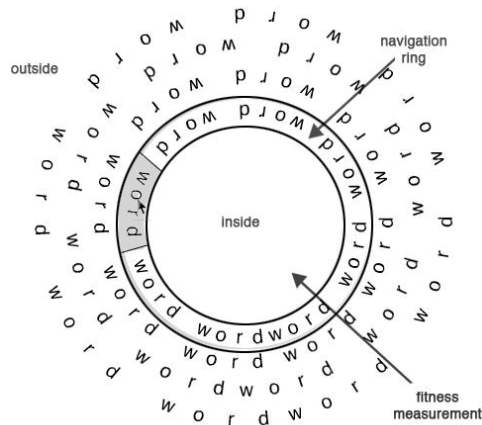


Fig. 31 theme fitness rating

The interface ring contains a physical model that responds to gesture inadvertent or intended and allows each participant to form a viewpoint by the creation of their own ring, that resizes depending on the amount of visible media. They may also grab and remove visible elements from the inside to the outside and use other gestural means to shift their ring around the search space. Interface rings can also merge as a result, combine contexts and form new outcomes and from this, facilitates the moderation of global and local relationships associated with thematic content. Embodied interaction is central to the system's relationship with its collaborators as it supports the role the participant wishes to play or enact through conversation by verbal, nonverbal or gestural means and allows switching roles dynamically between *narrator*, *player* and *observer* (Fig. 32).

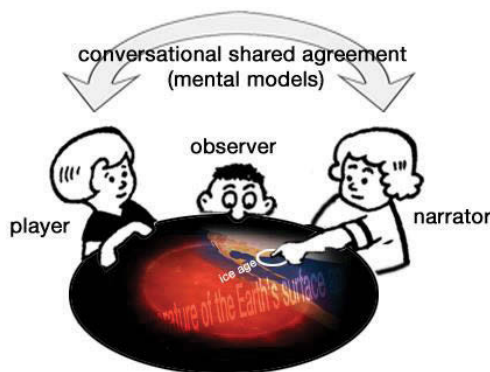


Fig. 32 role shifting - *player*, *observer* or *narrator*

These situated actions complete the system's reliance on participant engagement to guide through a coherent narrative space offloading contextual ambiguity open to interpretation or a possible space for generative meaning.

4.3.2.3.1 Interface Tier - Requirements

This interface concept relates directly as a solution to the *assimilate* system project, a multi-user system that is represented as an abstract system that is capable of distributed authorship and narrative generation. The interface looks to 'cover' the experience, or act as an avatar that grounds the experience for the user while attempting to manipulate the chaotic abstract search results. It is meant as a formal representation of how an abstract system can be used as such constructs metaphors that enable it to show what the system is attempting to do.

The interface must show how the system is creating and forming patterns that represent the collective search terms. The interface must represent how it is possible to 'contain' all of the possible chaotic network information into one abstract space that contains search results as spatially reorganised elements. Thus there is a metaphor for containing what is 'within' the systems boundaries and what exists outside its boundaries.

The interface system is capable of collective management that offers equality within the system. Not only do the search results compete but the participants may compete or in contrast they might collectively collaborate thereby adding to the collective weight of the search results. The interface must be capable of representing all users in the competing space.

The interface facilitates the usability of abstract art spaces. Abstract art may be representative of a language that is inaccessible to users, only system's code may hold how the behavioural patterns translate the various 'grammars' of the search results. Therefore the system offers an alternative way to represent what is being seen as the search language. This offers the participant a way to understand how the abstract language is being assembled.

Finally the interface must represent the 'flow' of the system or a continual reinterpretation of meaning for the system. The interface is seen to be eternally changing or 'turning' to show how abstract elements are being added and discarded.

4.3.2.3.2 Interface Tier - Description

The interface core is represented as a ring that may be opened or closed depending if the participant is actively manipulating the content. The ring is surrounded by system nodes that are representative of

content items that have been returned by the search requests. Each node encapsulates one set of behaviour patterns that are applied to its corresponding content item. The nodes are tags that are semantic representations of its content elements. Nodes compete to be placed within the search context, therefore are open to user input and system weighting to determine how relevance within the search context.

4.3.2.3.3 Interface Tier - Fitness Representation

Each node is given a fitness or weight within the system. This denotes its semantic pattern strength within the collective search criteria. The fittest nodes are placed within the ring and are known as 'inside' nodes. Inside nodes are visible inside the search space. The remaining nodes which make up the majority of nodes in the system are considered 'outside' and are in constant competition to the inside nodes and offer alternative choices for users to manipulate the patterns.

The *assimilate* interface shows each node and the associated keyword as either inside or outside the navigation ring. The nodes (keywords) on the outermost area are considered to be the weakest in the system while those represented as inside are the fittest. Any node word can be dragged inside or outside of the ring to modify the fitness of each node manually, this modifies the pattern information on the server. Essentially the *assimilate* experience runs on the refinement of chaotic information and nodes clicked on will instantly be removed, thereby affecting the overall pattern strength in the system.

4.3.2.3.4 Interface Tier - Experience Integration

The intention is to integrate the interface directly into the content experience without the need to separate content control into other areas. As the content experience is changeable, so is the interface in terms of its current size, colours and the collapse/expansion of the navigation ring. The interface attempts to overlay itself thereby not blocking any view of content at any time, this facilitates a more direct experience for the individual participant, the content however remains a collective experience.

4.3.3 System Example

The following outlines an example of how the framework is applied to the collaborative storytelling process. The tiered architecture is supported by a multi-user touch table that promotes gesture, verbal and nonverbal communication. The interface manages a collaborative environment that allows participants to visually construct narratives in an abstract virtual space. Narrative themes are assigned visual behaviours that are regulated by collective ratings. The system is a visual search engine that aligns participant themes with template stories drawn from a database of mythology and folklore (Thompson 1997) that springboards new collaborative narratives based on those themes (Fig. 33).

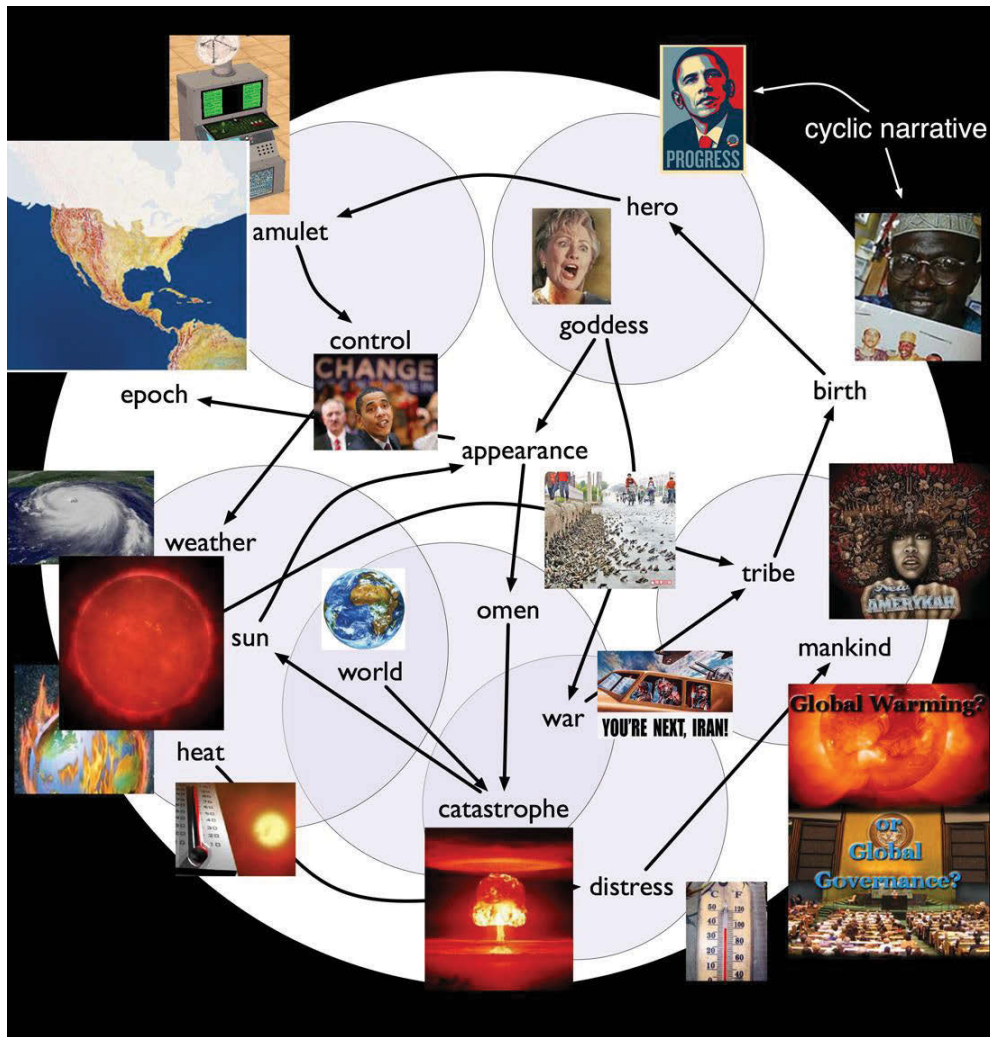


Fig. 33 visual story construction

The corpus has been transformed into a story grammar to ascertain common story relations such as narrative outcomes or events. Each theme is associated with a series of analogies with weightings that allow search themes to be aligned contextually. This example shows a narrative from the database:

A719.2. After world catastrophe, new sun reappears and starts new epoch. S. Am. Indian (Chiriguano): MÇtraux RMLP XXXIII 154ff.

In this case, a centuries old Indian myth surrounding a 'catastrophe' can be associated with modern issues such as 'global warming' and presented as a symbolic event in the template's narrative structure. Common sense databases contain many such analogous relationships that can associate everyday meanings with the example themes. Following CT's entailment structures, the themes contain derivable relationships are supported by at least two others, in this case 'catastrophe' may be supported by two other themes, 'nature' and 'war' that stem from other myths in the corpus. These themes are then added to the *Storyworld* to further episodic content to the existing narrative, forming sub-plots or differing outcomes

that break with the canonical. The assembled themes then reveal the possible procedural outcomes of the *Storyline*, here the procedural relationships can describe how events fit into the collaborative scheme, as 'war' might be seen as an episodic elaboration to the 'catastrophe' theme. Since CT entailment structures are cyclic, narrative themes may be revisited for further elaborations or forming new storylines. (Fig. 34)

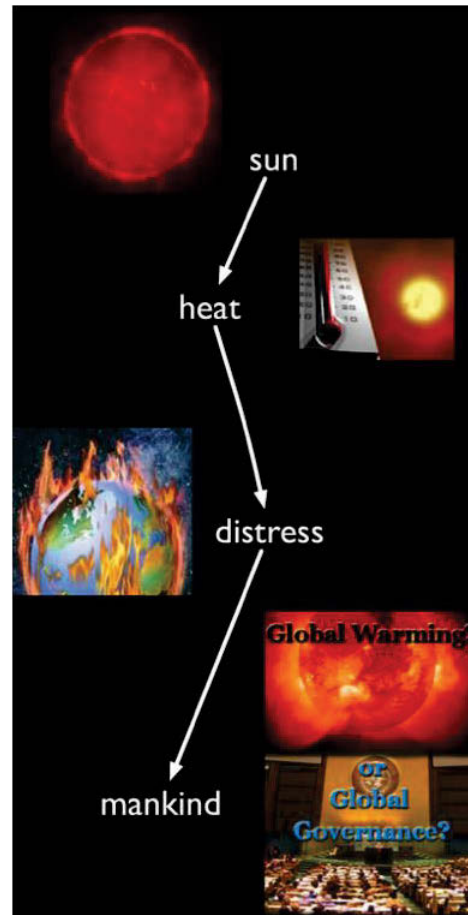


Fig. 34 visualised myth example

The collaborative process takes place in a situated context where gesture and conversation are mediated by the themes presented and allows participants to shift between roles as *narrator*, *player* and *observer* while maintaining a visual coherence. The example shows how a modern theme is derived from the myth or a hidden truth from our cultural history that is reinterpreted and enacted. It is this action that essentially promotes the shared understanding and intersubjective processes that complete the story.

4.3.4 System Framework - Discussion

The proposed framework places emphasis on sense-making and collective viewpoint to maximise creative potential. For this reason a simplified story grammar is favoured over narrative systems with complex rules and circumstances. Arguably, the system may be more suitable narrative modes that develop as

'streams of consciousness' rather than highly structured stories, however participatory narration allows for the possibility for a larger scope of generic themes and outcomes to emerge with rich collaborative experiences.

The advantages of a holistic design incorporates elements of our own embodied forms of conversational exchange and innate methods of story delivery and attempts to springboard or support the intentional aspects of collaborators. Furthermore, the dynamics of participant intentionality with the system's agency, or agency play (Harrell & Zhu 2008) is open to interpretation from the metaphors found within the template motifs, relying to some degree on the canonical recognition of popular narratives, or universals.

Collaborative emergent narrative systems must continually aim to provide coherence. Second order cybernetic systems, such as CT can potentially provide this within a specified and authored domain. The cyclic properties of these systems are inherently adaptive to collaborative input and potentially can cover a range of narrative styles and modes.

4.4 Discussion on Design of a Holistic System of Narrative Construction

The aim in this chapter was to outline how collaborative narrative and storytelling systems can generate meaningful content through the presentation of a holistic design. The situated actions with the conversational aspects of storytelling underlies the embodied nature of the process where the synergy of thought and action merge. The metaphors associated with embodiment can direct initial meaning into the modelling of narrative themes in a conversational form. This implies narrative coherence is the formulation from knowledge patterns from memories rather than sets of axiomatic rules open to arbitrary selection and measurable by quantitative means. This looks to the hermeneutic properties of narrative that constructs meaning from the constituent parts yet can only be seen in holistic terms and not empirically identifiable.

The future development of creativity support tools in this area, lies in the ability for collaborations to evolve dynamically with a semi-automated process initially seeded by community builders. The evaluation process outlined attempts to build a design whereby communities become self-managing once initial agreements are made. This is a process of cyclic feedback and interpretation and may be suitable to a range of narrative styles in a domain independent and scalable way.

Holistic system design requires an iterative approach that only practice based methods can illuminate. Here the method develops a mixture of qualitative and quantitative approaches to understand the potentials of interface play, knowledge acquisition and construction. This framework takes a broader view of its potential application for collaboration, one that places a focus on face-to-face group situations and emphasises how our mental models and intentions are understood by others, and not necessarily by the system itself. This supports situated action, where the enactment of narrative by participants is mediated by the conversational knowledge generated by the system. Such systems look to holistic paradigms of information retrieval and exchange that combine logical and affective thought to deliver a coherent experience. The systems design can favour such schemes by offering a unified architecture, starting with narrative templates that are recognisable from our cultural backgrounds, feeding up into a real time process of shared negotiation of themes through embodied conversation that is mediated by a novel interface. The interface should take on an expressive appeal that renders visible its inner processes and allows collaborators to shift roles from *narrator*, *player* and/or *observer*.

Modelling the thematic relationships in a conversational form, such as Pask's entailment structures, allows for a cyclic interpretation and may be suitable to a range of narrative styles in a domain independent and scalable way. CT entailment structures can connect concepts using common sense and rhetorical relationships that extend the meaning beyond the literal boundaries creating a link with our cultural narratives that the system itself cannot capture. This holistic aim of negotiating agreement and sense-making was largely the motivation of Pask's CT and there is much relevance of his work to networked collaboration, as there is to interactive narrative research.

5. Results

5.1 Introduction

This chapter will present results of a series of evaluations developed for the *assimilate* system presented in Chapter 4. The evaluation process is aimed at understanding the participant experience of collaborative narrative using the system. This would measure the value associated with narrative coherence and if the system itself aided or supported these outcomes. A narrative is considered coherent if the contained concepts and metaphors are made meaningful to the participants in the shared experience. This is an attempt to illuminate how the participants reflect upon the experience and the actions they took in combination with the system's feedback, as well as the actions of the other participants. Methods that can retrospectively evaluate an experience is favoured, as the value of the knowledge generated can only be understood, evaluated and ultimately reflected upon during the time that the associated modalities with the experience were unified.

The evaluation methods, as outlined in chapter 3, developed a record of all sessions logged into a database. This includes, media generated, what sets of concepts were compiled collaboratively (*Storyworld*) and what narrative sequences were generated from those concepts (*Storyline*). A video playback displayed the actions participants took with the interface and the conversations they exchanged. The participants could rate each narrative sequence as being meaningful to their collaboration and also discussed the actions they took during the experience.

The results identify three design features that were found to support collaboration and in some cases led to increased narrative coherence:

- the interface schemas for supporting conversation and narrative
- system design for developing collaboration
- the conversational system design.

The sections will firstly outline a report of 7 evaluation studies coded as (PHM2009, CCS2011, TASIE2012, TT2013, GS2015, GS2016, CCS2016). This is followed by an analysis of these results and categorised into the three design features shown above and finally a chart outline and summary.

5.2 Evaluation Studies

The following outlines a series of results from each of the evaluations below. All evaluations have been coded (PHM2009, CCS2011, TASIE2012, TT2013, GS2015, GS2016, CCS2016), that will be referred to during the analysis.

5.2.1 Evaluation 1 - BetaSpace, Powerhouse Museum 2009 (PHM2009)

No of Participants: 2 groups; 3 participants each

Demographics: Male/Female, ages 24-39

Occupations: Student, Educators, Art Practitioners

Methods: Observation (EM1), Unstructured Interviews (EM2)

Location/Date: BetaSpace, PHM, Sydney, Australia / June 2009.

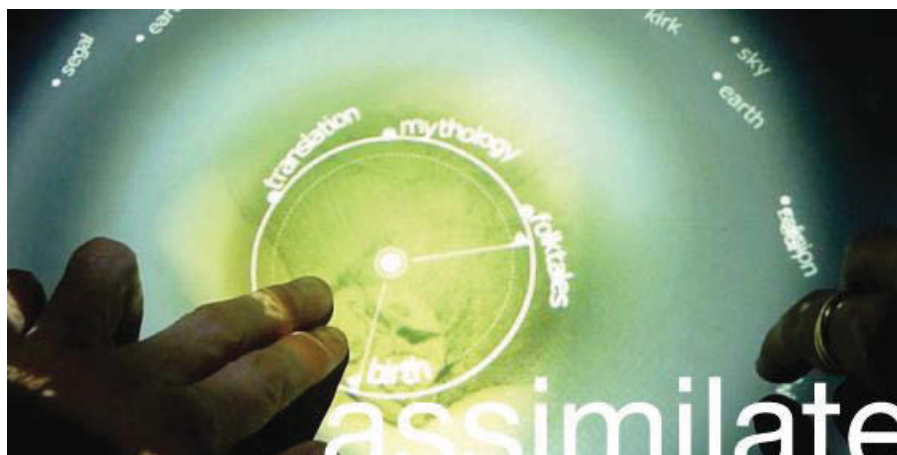
System:

Corpus - internet search results

Software - Client, 3D Director version; Server, java

Hardware - Mistubishi DiamondTouch - pressure sensitive touch table with top down projection.

Images:



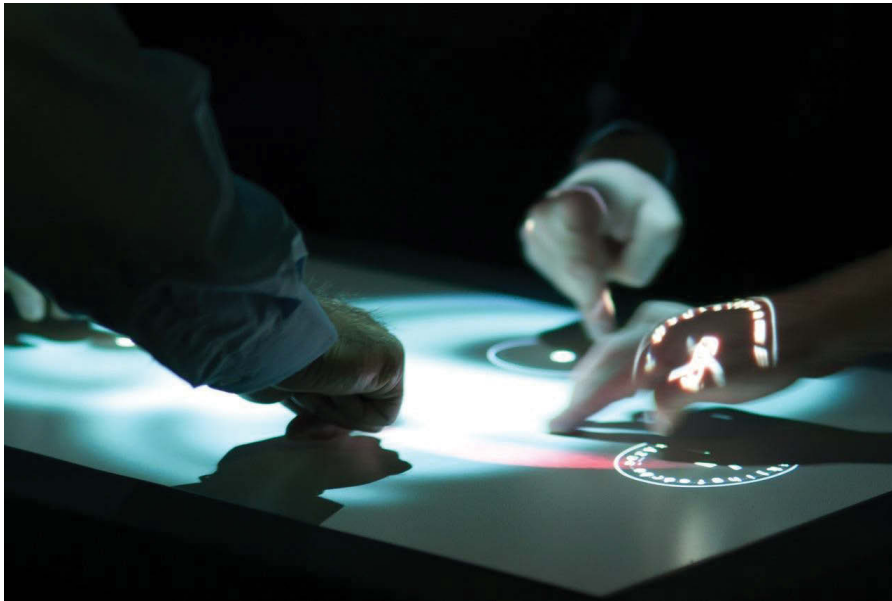


Fig. 35 evaluation 1 - BetaSpace

Description:

The work was first hosted in the Powerhouse Museum, BetaSpace (Fig. 35), a special exhibition space developed for practitioners to evaluate their works with the general museum public. This design iteration, mainly observation studies were conducted with short interviews of feedback.

During evaluation, several groups were observed. One group was a family with established relationships. For this initial group, the process of conversation allowed some sense-making to develop, in that one member of the group instructed or encouraged others to explore the interface mechanics. The participants were then able to experiment without apprehension and allow collaboration and conversation to take place.

This led to some playful or otherwise instructional outcomes. While the interface system was still early, the accessibility and ability to gain instruction through others was identified. Once instruction had been given by one participant followed a demonstration, others were much more inclined to participate.

Due to a simultaneous event at the museum, a group of art practitioners were able to participate. With a more careful and measured response to the interface, the mechanics were explored and discussed in a more open way. Conversations were directed towards more collaborative outcomes. Some were asking others to join in with their media, or speculating on how concepts could be merged what would eventuate. While two of these participants had brought up political search themes, others were more abstract, such as colours or mythological themes. When merges were eventually made, some indication that a new experience was made or that 'joining' of one political concept with one abstract concept developed something new. As one participant said that they saw concepts 'drawn together' and form something different.

This early iteration had demonstrated a number of key indicators of collaboration. Firstly, the area of the BetaSpace was a separate more intimate space designed specifically to allow participants to work with the installation without distraction. This space along with the touch table placed in the centre of the room, allowed participants to openly discuss events in a more democratic way. This developed a more intimate and playful environment that encouraged collaboration through conversation and gesture.

This evaluation demonstrated that conversation, staging, encouragement and the willingness to collaborate developed more interesting and varied outcomes. Staging allowed the conversation to flow freely, and further encouragement for exploration when concepts were shown and merged.

5.2.2 Evaluation 2 - CCS Studio (CCS2011)

No of Participants: 1 group; 2 participants

Demographics: Male 23, Female 22

Occupations: Design Students

Methods: Observation (EM1), Unstructured Interviews (EM2)

Location/Date: CCS studio, Sydney, Australia / Nov 2011

System:

Corpus - Internet search results

Software - Client, 3D Director version; Server, java

Hardware - Mistubishi DiamondTouch - pressure sensitive touch table with top down projection.

Images:



Fig. 36 evaluation 2 - CCS Studio

Description:

This iteration (Fig. 36) developed the mechanics to more playful and engaging experience. Two notable groups participated, firstly a group of undergraduate design students and secondly a group of postgraduate students in IT. The design students spent time investigating the possibilities with the mechanics. They tended to adopt an open view as to what the interface could do, and generated several examples of new combinations of search content. The post-graduate group were all trained in IT and displayed an interest in how the system itself operated rather than working towards collaboration. This method of exploring the inner workings of a system did not lend itself directly to collaboration. Some were games students and were able to play along with the mechanics and have fun with the physics of the interface. Although this led to interesting possibilities, the output of the interface was not satisfactory in terms of generating meaning. This is related to the approach taken by the participants, as a software developer might treat the experience differently to a regular user. While the IT student is focussed on the direct output of the system to generate meaning, others may see how they themselves can participate in the meaning and subsequently what each collaborator may bring to the experience. This particular mindset of the participant is important to the design. The playful aspects of the interface could invite the participant to adopt a more open attitude to how the experience is developed, although it would be ideal to cater for all types of participant approaches, it is clear that future evaluations should take place with this context in mind.

5.2.3 Evaluation 3 - TASIE exhibition (TASIE2012)

No of Participants: 2 groups; 2-3 participants each

Demographics: Male/Female, ages 20-35 approx.

Occupations: Unknown; Educators

Methods: Observation (EM1)

Location/Date: China Science & Technology Museum / Nov 2012

System:

Corpus - Internet search results

Software - Client, 3D Director version; Server, java

Hardware - Mistubishi DiamondTouch - pressure sensitive touch table with top down projection.

Images:

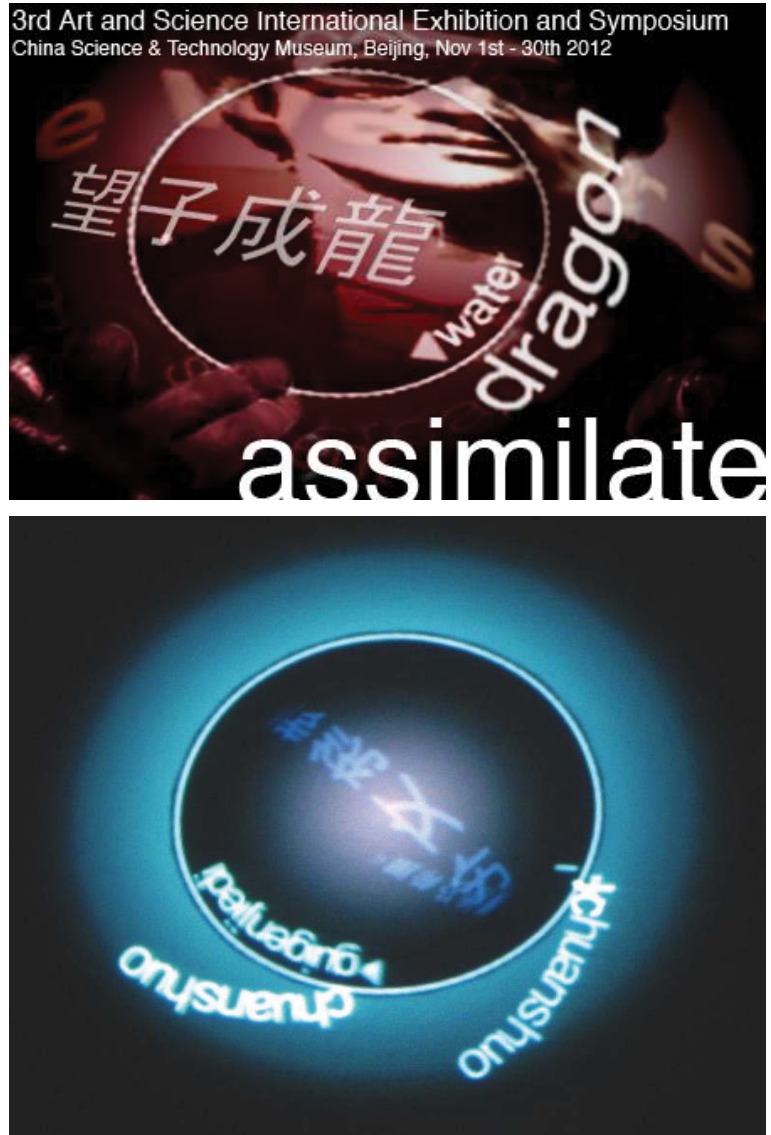


Fig. 37 evaluation 3 - TASIE Exhibition.

Description:

This evaluation took place in China museum as a part of the 3rd Art & Science International Exhibition (TASIE) (Fig. 37). A dedicated space again, this iteration included a special Chinese language version. Tag texts were converted into pinyin and while chinese characters themselves were used in the text media display. Several groups were evaluated, including a family with established relationships and others whom did not know each other. While the finer details of what was done with the interface were not always known due to language barriers of practitioner and participants, a few were able to convey their thoughts using english. In general the families communicated a lot with each other, and gave specific instruction to one another about what they were doing. It was found that meanings generated by the system had somewhat of a wider scope, and produced a range of meanings that could be interpreted in many ways. For example, the word for 'dragon' in Chinese is 'long', but in certain contexts it can have many meanings. Although it was difficult to pinpoint the varying meanings with the Chinese groups, a general conclusion was that their willingness to enjoy the experience with their family members gave

them the particular attitude that allowed collaboration to take place. From this it can be seen that participant attitudes have a significant role within successful collaborations. Furthermore, it can be seen that the mechanics of the interface with the Chinese participants able to see something within their own cultural identity gave them the willingness to participate and experiment.

5.2.4 Evaluation 4 - Transreal Topologies Exhibition (TT2013)

No of Participants: 1 groups; 3 participants

Demographics: Female, ages 24-32

Occupations: Art practitioners, IT professional, Management

Methods: Observation (EM1), Unstructured Interviews (EM2)

Location/Date: RiAus, Adelaide, Australia / Oct 2013

System:

Software - Client, 3D Director version; Server, java

Hardware - Microsoft Kinect with top down projection.

Images:

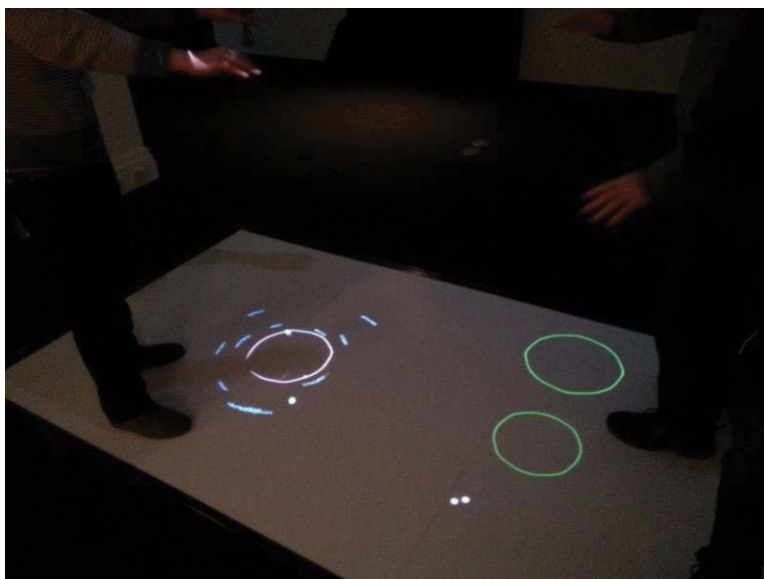


Fig. 38 evaluation 4 - MarArt: Transreal Topologies.

Description:

This evaluation took place during the MarArt4: Transreal Topologies exhibition, as a part of the ISMAR13 (International Symposium of Augmented and Mixed Reality) Conference at the RiAus - The Science Exchange (Fig. 38). The work in this iteration was adapted as a full body experience controlled by gesture enable technologies and a surface area covering a section of the exhibition space. While the interface mechanics were identical to previous iterations, the scope of gestures allowed for more interesting variations on the collaborative and conversational aspects of the work. Observational studies were conducted on various groups with some feedback during and after the process. The surface area catered for 3-4 people to activate the interface at any one time. A key observation was the conversational process taking place during and together with a social activity. For one particular group during the opening night, discussions were taking place similar to how groups might typically converse in smaller groups while observing the media at their feet. Each taking in turns to activate something, merge rings together within a jovial atmosphere and commenting on outcomes. Situation and staging were key aspects of developing collaboration, this demonstrated how the interface was able to incorporate itself into a common social activity without dominating it, yet seeding new conversational aims when someone took control as narrator.

5.2.5 Evaluation 5 - UTS Game Studio (GS2015)

No of Participants: 2 groups; 4 participants

Demographics: Male, Female - 26-38

Occupations: Graduate Students

Methods: Observation (EM1), Unstructured Interviews (EM2)

Location/Date: UTS Games Studio, Sydney, Australia / Feb 2016.

System:

Corpus - Science fiction film

Software - Client, WebGL/threejs; Server, java

Hardware - 10 point multitouch monitor

Images:

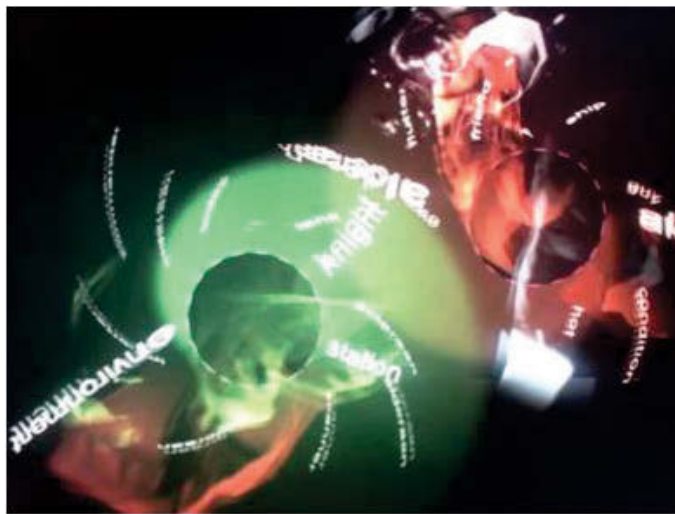


Fig. 39 evaluation 5 - UTS Game Studio

Description:

The is the first two iterations of the HTML5/webGL front-end of the system, using a 10-point touch monitor (Fig. 39). These versions also contained a corpus of video segments from one specific long form narrative, or feature film. The film in the case was a famous science fiction film chosen for its familiarity with the story. One of the key design aspects, familiarity of the story world, should allow participants to formulate their own world view and have that shareable with others. The interface mechanics were vastly improved from previous iterations allowing for more freedom with gesture, although this also led to loss of coherence due to the responsive nature of the physics. From this iteration there were many improvements and tweaks made to the physics to limit the amount of interaction to maximise coherence. The feedback from the test group showed that there were cognitive limits on the amount of simultaneous narrative sequences playable at one time. To further the design goal of role switching

(player/narrator/observer), sequences would only play upon interaction, such that it would draw focus to the participant who was making the action at the time. Only when participants are making actions did the sequences trigger and this improved for the follow up group/iteration. Both groups reported increased recognition of the narrative flow and coherence directly related to the media and story familiarity that was not entirely apparent on previous iterations. This result shows that story world familiarity increased the overall coherence of the narrative. By containing the story world as one corpus of video segments with a familiar story, the gestural component was notably enhanced.

5.2.6 Evaluation 6 - Games Studio (GS2016)

No of Participants: 2 group; 2 participants (same participants; beginner to expert level)

Demographics: Male ages 28,29 - Chinese Born

Occupations: Graduate Students

Methods: Observation (EM1), Video Cued Recall Interview (EM3)

Location/Date: UTS Games Studio, Sydney, Australia / Feb 2016.

System:

Corpus - 1986 Mandarin language fantasy TV Series; Science fiction film

Software - Client, WebGL/three.js; Server, java

Hardware - 10 point multitouch monitor

Images:





Fig. 40 evaluation 6 - Games Studio

Description:

This is the second iteration of the WebGL version with a 10-point multi touch monitor. For this evaluation, participants were evaluated with familiarity of narrative and culture (Fig. 40). The narrative corpus contained a famous television series made for a mainland Chinese audience in the 1980's. This was selected specifically as most Chinese people have seen this series at least once or twice and are familiar with the story. Participants were all born in mainland China and fluent in Mandarin. During the session much enjoyment was derived from aspects of the story. This was usually something that was said by characters that a participant would identify with. The word corpus was not used for this, and a number instead of word depicting the media element was substituted. It was assumed that the number would not interfere too much with other aspects of the narrative coherence, however this turned out to be a large problem for participants. It was identified that media annotations were highly important to the coherent organisation of the narrative sequence. Also problems were reported of the numbers attached to the ring itself. One participant reported a disconnect between the media seen inside the ring and the number currently attached. From this feedback, one possible design solution is to have the media annotation flowing inside the ring.

While this evaluation was focused on aspects of familiarity, the significant feedback centered on aspects of the collaborative process itself. Both participants had very differing attitudes towards aspects of collaboration and the general desire to participate in collaboration. For one participant, the other became somewhat of a minor annoyance and preferred to concentrate on their own experience. The other participant however, was open to collaboration and at one point forcefully merged their ring with the other participant. When this event occurred, there was a distinct pause in interaction while each studied the effect of the merge on their content. After this brief period, the less cooperative participant attempted to return control by making gesture towards the merged ring, then shortly after opted starting a new ring within their own space. During the recall sessions, both participants expressed a desire in general against the merge, however they accepted it. The more cooperative participant who instigated the merge accepted this outcome more readily than the other. This clearly demonstrates that the interface attempted

to force an agreement stemming from one participant's initial desire to merge. Once the merge had taken place, while not openly enjoying the outcome, it was generally accepted.

A follow up evaluation consisted of the same participants using a well known science fiction film corpus. This contained words instead of the numbers. Although the participants were less familiar with the corpus, the word tags were welcomed. Both participants were considered experts in the interface. During the first evaluation it was noted that each participant tapped their rings in a generally aggressive manner. This is largely due to their experience of playing video games and their ability for rapid engagement and reactions. This demonstrated the lack of feedback to show if the ring was actively playing or waiting for input to play a sequence. For this a minor design modification was made to emphasise the ring sequence was active. This was immediately noticed by the participants and they refrained from excessive tapping and could see when the ring had responded. This allowed them to reflect more on the content playing. The process of collaboration flowed more smoothly, and several merges with some reflection on the outcomes. Although the narrative aspects were still largely convoluted, the participants welcomed the ability to enjoy the cooperative mechanics in a more playful and unconstrained manner.

With this evaluation, there were clear definitions of how participants came to accept the need to collaborate or explore those options. In part the mechanics supported an intention to merge and the subsequent outcome was accepted if not tolerated. In general aspects of the narrative content itself remained largely problematic in terms of structuring a coherent sequence. One participant suggested that content should be more of a visual nature rather than strict narrative sequencing. Perhaps this alludes to the possibility that less narrative structure allows more of a direct involvement personally with content. This question remain an interesting aspect of these designs that require more personal engagement.

5.2.7 Evaluation 7 - CCS Studio (CCS2016)

No of Participants: 1 group; 2 participants

Demographics: Male 45+, female 26

Occupations: Graduate Students; Art Practitioners

Methods: Observation (EM1), Video Cued Recall Interview (EM3), Theme Survey (EM4)

Location/Date: Creativity and Cognition Studio, Sydney, Australia / Feb 2016.

System:

Corpus - 'La Jetee', Chris Marker; 1962 - short film, 28 minutes (*La Jetee*, 1962)

Software - Client, WebGL/three.js; Server, java

Hardware - 10 point multi-touch monitor

Images:



Fig. 41 evaluation 7 - CCS Studio

Description:

This evaluation was conducted in two stages (Fig. 41). The first an exploratory stage to discover aspects of the interface without instruction. The second stage followed a brief question and answer session where the basics of the interface were explained. Participants during the first stage made some incorrect guesses about the interface mechanics that highlighted issues with the visual design and also aspects of its mechanics. They made the assumption that items needed to be dragged out of the ring in an effort to isolate and watch the segments independently. The montage created inside the ring was found to be confusing and one participant was not able to correlated the salient images and sound together. To address this issue, the central image montage needs to increase its visibility and have the others fade while not playing. The feedback also suggests the audio requires a similar spatial treatment with regards to the use of panning. Audio levels can be adjusted based on the spatial arrangement of the rings. Furthermore, the central aspects of the ring are too cluttered with one solution suggested to stretch the

space for the outer tags and images. This first stage process showed the need for the cinematic experience to be finely tuned for it to operate more intuitively with the interface metaphors.

During the second stage, after explanation of the basic interface operations, participants felt more comfortable with general engagement. Participants clearly showed a relationship to their respective ring and the canvas space it occupied. In general there was a much more considered approach to collaboration. One participant expressed a concern about the possibility of disrupting the engagement of others. Within their own respective experiences, both participants were comfortable with ring mechanics, such as dragging in and out tags from the outer areas. In general this also includes moving elements from the centre to the periphery and also to other rings. When a participant moves a tag to another, metaphorically with the mechanics, this is known as exchanging a view. In this case, the participant made an intuitive guess based on previous knowledge of interface actions. This could best be described as a systematic guess, or one based on a set of similar actions that would be considered 'natural' to the ring's mechanics. This is a good indication that the ring's affordances are consistent.

After a time, one participant decided to push their ring towards the other. While not having a direct intention beyond play, he sent it off for a 'visit'. Once the merge was made the acceptance of it was evident, beyond this both participants described the merge as 'interesting'. This demonstrates the ability of the interface to generate collaboration from the smallest intention to collaborate. While interesting is not definitive of enjoyment, there is evidence to suggest that the interface from a simple playful aspect developed a merging of ideas and some generated interest in its outcomes.

In some cases the mechanics directly assisted with collaboration. This was also related to the content chosen in this case. One participant discussed at length the suitability of the corpus to the interface collaboration. The film 'La Jetee' (*La Jetee*, 1962) directly calls into question of how coherence in narrative is developed. Sorting through a particular set of circumstances and making sense of time added to the experience to the physical properties of each ring. Aspects of discovery, the passage of time and memory each gave the narrative experience more potency. In this evaluation, one participant had seen the film before, the other had not. This became an interesting exercise in familiarity, as one participant narrated their past experience of the film to the other participant. This shows verbal conversation as a supplementary tool for developing narrative coherence in conjunction with the nonverbal aspects of engagement. The theme correlation survey only scored low with 2 of 54 themes within the corpus selected by both participants, yet it does demonstrate some minor correlations.

This evaluation highlighted design improvements in reducing clutter around the central parts of the ring. It also suggested that certain narrative corpus lends itself better to the interface mechanics. Narrative familiarity played an important role and suggests particular stories are more suitable especially when targeted to particular audiences.

5.3 Design For Narrative Coherence - Analysis of Results

This section will present an analysis of the evaluation sessions detailed above with a focus on the three design features including:

- Interface Schemas For Narrative Comprehension
- Developing Collaboration
- Conversational System Design

5.3.1 Interface Schemas For Narrative Comprehension

Interface schemas are reported in two sub sections, supporting collaboration and specifically supporting conversation and narrative.

5.3.1.1 Interface Schemas Supporting Collaboration

The interface schemas are designed to support the collaborative conversation be it verbal, non-verbal (gesture) with the other participants. Working as a part of the collaboration with a ‘natural’ process of storytelling with shared and dynamic narration.

The results indicate that aspects of the storytelling metaphors are effective in communicating intention with the general use of digital canvas space. This was particularly evident during evaluations CCS2011, GS2015, GS2016 and CCS2016. For GS2016 and CCS2016, participants noted when others took control or dominated the space by use of the *scale* schema that allows resizing of the ring. When a participant’s ring was scaled to maximum, this would ‘interrupt’ others or if they were just observing draw attention to the sequence playing within the dominant ring. The group from CCS2011 took issue with this form of interruption however, as the enlargement and subsequent *merging* of rings was unwarranted. Feedback from CCS2011 was to somehow hold off interruption by means of gesture until both parties were ready to merge. A change was implemented that would prevent rings from merging in the case and sequentially became useful in later iterations. However one design feature based on the literature is to cause typical and well known narrative to be ‘interrupted’ as a way of triggering novelty and drama. In this instance perhaps there is a balance to be made with preventing the merge during particular actions, and allowing new ideas to generate through happenstance.

As for *container* and *centre/periphery* schemas, these are designed convey a personal space of building and interpretation, that contain a participant ‘point-of-view’ or characterisation based on the media within their personal ring. Nearly all evaluations demonstrated some understanding of what each ring meant in terms of a gathering of data around a central space to see what was in focus. The tag/media combinations were clearly seen moving towards a central place where some energy formed, or ‘black hole’ as one

participant from GS2015 stated. From this statement and others similar to it, we can infer that a natural form such as a galaxy or whirlpool can clearly show objects moving in and suggests particular affordances such as dragging items 'out', or what is 'inside' the ring. Groups from PHM2009, CCS2011, GS2015, GS2016, CCS2016 all quickly understood the concept of dragging 'inside' to 'outside' the ring. This included the ability to flick out and delete the media and also to drag into another ring or *exchange a view*. This view exchange metaphor was discovered by one participant in CCS2016. This demonstrates the ability to follow through on intuitive play to work out more advanced features of the interface. The CCS2011 and GS2016 can be viewed as advocates of containing their views until they are ready to merge them with others. Ideally the interface should adapt on the basis of both approaches. These schemas were found to support develop coherence through metaphorical 'boundaries', the physical boundary of the ring itself, and this assisted with regulating cognitive overload when too many merges and actions were taking place.

5.3.1.2 Interface Schemas Supporting Conversation and Narrative

The interface schemas also have several design aims beyond base mechanics. In general, they are developed to convey or extend the space of narrative meaning within the conversation. They aim to enhance narrative comprehension in the minds of the participants and importantly convey intention with the conversation process. In general this was far harder to evaluate if these designs were capable of extending a conversation due to numerous factors. Mainly the difficulty with identifying a narrative component and if a certain gesture and correlated interface schema was all working towards the intended 'goal' of the participant. This can be attributed to understanding if the experience for most participants contained narrative goals rather than goals that were emergent over time. However it was clear to see that these supported participant intention with respect to a gestural act and affected the narrative sequence in some way and thereby modifying the intended conversation in some new form. Therefore it may be stated that the schemas can support collaborative conversation however it was uncertain as to how they directly affected the narrative intended or otherwise.

5.3.1.3 Interface Schemas Supporting Collaboration (ISSC) - Tabular Analysis

This table shows level of participant understanding of each schema during the collaboration. These can either come up during the experience (and later verified in interview) as a mention during speech and/or performed with a gesture/non-verbal action.

- None - no active mentions or gestures
- Marginal - mentioned (or partially performed) but not completed
- Partial - mentioned and/or performed at least once by one participant
- Decent - mentioned and performed at least once by one participant
- Full - mentioned and performed by at least 2 participants and performed 1 or more times by each.

Evaluation Session

ISSC Type	PHM2009	CCS2011	TASIE2012	TT2013	GS2015	GS2016	CCS2016
Point Of View	Partial	Marginal	Marginal	Marginal	Marginal	Partial	Marginal
Merge	Partial	Marginal	Marginal	Partial	Decent	Full	Full
Scale	Partial	Partial	Marginal	Partial	Decent	Full	Full
Exchange View	None	None	None	None	Marginal	Decent	Full
Container	Marginal	Marginal	Partial	Partial	Decent	Decent	Decent
Centre/ Periphery	Partial	Decent	Marginal	Partial	Decent	Decent	Decent

Fig. 42 ISSC – level of participant understanding

This table shows the development of the schemas, which in general improved over the iterations. While some schemas were consistent such *centre/periphery*, others were not developed until the interface mechanics improved, such as *exchanging view*. This also showed that participants were exploring the possibilities of this particular schema before it was implemented, verifying its applicability through play and experimentation. Others such as forming a *point-of-view* were harder to identify as this was more to do with participant attitude, and this had to be reflected in some speech or feedback. However, the two main schemas developed, *scale* and *merge* were both improved upon over the iterations and were reported as generally useful to developing the collaboration.

5.3.2 Developing Collaboration

Developing and supporting collaboration is a crucial design aspect of the work, in that it drives participants to recognise the narrative intentions of others and allow role switching as *narrator*, *participant* or *observer*. System mechanics should support collaborative conversation and narrative creativity with a more natural process of engagement and allow participants to individually and collectively take particular views or perspectives with narrative content.

For some groups, collaboration and conversation became a natural process of discovery as was observed in PHM2009. This group in particular were art practitioners or had experience with collaboration through

practice. Discovery and understanding of interface operations were discussed openly. From this early iteration it was found that if participants were 'open' to disruption of activities by another, such as a ring merge, more effort was made to understand the outcomes. This is also backed up by the literature that suggests creative emergence is developed by a group with some training specifically in collaboration, such as improvisational theatre. Here similarities can be seen where participants are open to taking a fall for example, to develop the narrative experience for the others.

However it was also found that many participants did not have much experience with interfaces designed specifically for collaboration. This may be related to how common interactive digital technologies, such as smart-phones, generally operate as singular experiences. In some cases having another person in the space was seen as distracting away from what they were constructing themselves. Some evaluation groups such as CCS2011 and GS2016 had some reservations about the interface mechanics 'disrupting' the experience of others. For those participants whom protecting their personal space (ie ring) that are forced inadvertently to collaboration by the mechanics, this opened up their involvement into more interesting narrative segues. While it is not conclusive that interruption or disruption can engender a definitive narrative experience, there is some feedback that suggests it can, given as one participant said, 'an interesting result'. The GS2016 and CCS2016 sessions displayed two opposing views of ring disruption through merging. In both instances all came to acceptance of the final result, while GS2016 displayed indifference, the CCS2016 participants welcomed the merge as interesting.

Dynamic role switching also was verified through the interview process for PHM2009, GS2015 and CCS2016. These groups noted when another took control of the experience (*narrator*), or when one would move in relationship to the narrator or protect their ring from merging and prune their space of tags (*player*). Finally some shifted into observation roles - 'I thought I would just see what the others were doing' (*observer*).

In summary favourable circumstances for collaboration were developed through an active participation or a specific attitude that was more open to the possibilities. There were also some indications that narrative could develop through a modification or inadvertent change in the interface mechanics, or unexpected merge of rings. Finally some dynamic role switching was evident with some unexpected and emergent outcomes.

5.3.3 Conversational System Design

This section details results of the system design as a part of the 3-tier software architecture modelled specifically to work with the interface presentation layer. The main design aim here is to develop the system as 'conversational' in that it supports the process of a group conversation. The system is inspired by Pask's Conversation Theory (CT) as detailed in Chapter(s) 2,4, shows that it has a number of useful features that lend itself to collaborative knowledge representation. The findings here are presented in two sections, firstly the ability for the system to maintain a consistent context (*StoryWorld*), next the

presentation of a narrative (*StoryLine*) and finally a summary of how the system is able to integrate its modelling with the interface requirements.

5.3.3.1 Maintaining a Context - defining a *Storyworld*

Within CT, the maintenance of context is facilitated by entailment networks as explained in Chapter 4. These non-hierarchical domains of knowledge that contain simple relationships in complex networks. These networks are designed to be generated through actionable means, in other words through collaborative outcomes. Template narratives provide the base sets of relationships that are built upon by successive activities of the system. For this reason they are regarded as representative of knowledge accrued over a period of time and reflect a common set of values by a group or community. The *assimilate* work attempts to record these values for re-use either through successive iteration or immediately upon *agreement* of those values. The process of agreement was a significant part of what Pask wanted to achieve with his CT pruning process. Agreement within the system design is directed by the interface metaphors that is then recorded within the system processes when such a metaphors arise, ie *merge*. The results should show that once an agreement is made by the participants and reflected in the interface mechanic it should also produce a knowledge representation that is meaningful to the group or community that created it. Additionally the template knowledge should provide the seed of meaning behind those accrued after it.

Participants were asked to firstly identify the body of knowledge they were working with as baseline and further asked to describe the subsequent relationships produced by each session. For evaluations between 2009 - 2011 a keyword search implementation was matched by a corpus of mythological themes. While participants could easily explain the search results, little connection with the baseline relationships could be made. While this is not a large issue, since the narratives contained in the myth database we only designed to show the event relationships. As these are the relationships that resonate with stories throughout history. However developing their own search result gave them a sense of ownership over the knowledge and a larger understanding of the context they created.

For later iterations, the system provided more established context in the form of a video segment corpus from a either a single feature or short film/tv show. This allowed participants to easily recognise familiar story worlds. Familiarity of the story world is identified as a key aspect of the design, as it provides a smaller context to iterate new layers of narrative content. Participants could clearly understand the creation of a 'fictional world' boundary, in that the *Storyworld* contained a set of its own narrative possibilities, bound by the common sense and logic associated with that world.

Both methods search result and video corpus contrast two examples of how the system attempted to develop a *Storyworld* context. While the first example gave participants a closer relationship to the content the second provided a more contextually coherent world. Both features are seen as desirable, further explanation of how such a system could work is explained in Chapter 6.

5.3.3.2 Generating a Narrative - developing a *Storyline*

Within CT participants may shift around the conceptual relationships within the entailment networks in any arbitrary direction. Since entailment networks bind together context that is actionable, each relationship provides a procedural context that maintains coherence. The networks are inherently *cyclic* (see chapter(s) 2,4), meaning that maintain a coherent context regardless of how procedures are navigated. This allows collaboration to collectively shape the meaning and adopt varying viewpoints or perspectives, all highly applicable to collaborative narrative generation. Within the systems mechanics, each ring sequence corresponds with procedural context of the current entailment network.

To validate this design feature, each sequence should provide a coherent meaning generated from the entailment network. Furthermore, each participant will have their own views within the collaborative context yet should be able to share those meanings in part with their collaborators. Some evidence was gathered to support this notion, however the difficulty comes with understanding the complexities of meaning within a group context. It is to be expected that the system will generate a significant amount of mixed meanings depending on what participants are constructing. The design aim is to minimise this amount such that some aspects of the collaboration will construct something of interest and novelty. In summary, simple examples clearly contain better procedural elements that tend to correlate meaning between participants. However they only produce smaller sets of variations. Larger corpus contains less correlated meanings yet the possibility for more interesting output. Some balance of the two is necessary as too much non-coherence only serve to inhibit collaboration.

5.3.3.3 Conversational System Summary

Both the *Storyworld* and *Storyline* are derivative of CT's declarative and procedural mechanisms contained within entailment networks. Together they form an application layer that is required to self-organise and support the interface component and its collaborative mechanics. The processes should be in some way 'visible' to participants, not in any direct representative way, rather corresponding to visual media elements of the presentation layer that are sequenced and organised. This theoretical standpoint of design comes from allowing participants more direct access to how the underlying processes work, and in turn provides more context and coherence. Through this method and the two layered application architecture, the system should develop and regulate a conversation and have those processes more receptive of participant intention. If the interface metaphors provide coherence with conversational acts the system design should also assist in the knowledge gathering and context development. The findings suggest that the system did provide contextual meaning to the group conversation. Although the actual CT process model did not suggest any greater level of integration with the presentation and database

layer, its specific aim of coherence generation did to some degree assist with the other aspects of the system.

5.4 Summary of Results

The following section will summarise the results of six evaluation studies and results of the three main design features (Fig. 42) that were found to support narrative coherence in collaborative contexts.

These design features include:

- the interface schemas for supporting conversation and narrative
- system design for developing collaboration
- the conversational system design.

Firstly, the interface schemas were shown to support collaborative conversation surrounding narrative contexts. The interface visual form and physical properties provided a set of responsive metaphors that were clearly understood by participants. These include developing and containing a personal *point-of-view* within a narrative, assisting with non-verbal conversation, providing a metaphorical boundaries and showing how concepts may *merge* with the possibility of generating novelty.

The interface design features were also found to develop collaboration through the mechanics. When a modification to participant rings either done purposefully or inadvertently, this was found to direct the narrative into new directions providing new emergent outcomes that contributed to coherence. This allowed participants to make quick changes in roles as *narrator, player or observer*. However, results were improved when the specific attitudes of the participants were open to narrative engagement.

The system inspired by CT principles, with a two-layered approach of *Storyworld* and *Storyline*, was found to develop *agreement*, a CT principle by which a group understanding takes place. This also allowed for clear boundaries of context given a strong familiarity with a *Storyworld*, or a constrained corpus of templates. The meanings between participants correlated better with a smaller corpus with greater coherence. Larger sets developed less coherence but greater variants and more interesting outcomes.

When these three design features are combined within the software architecture with some form of natural user interaction, it was found that collaboration was supported and in some cases this led to an increase in narrative coherence.

Database Tier

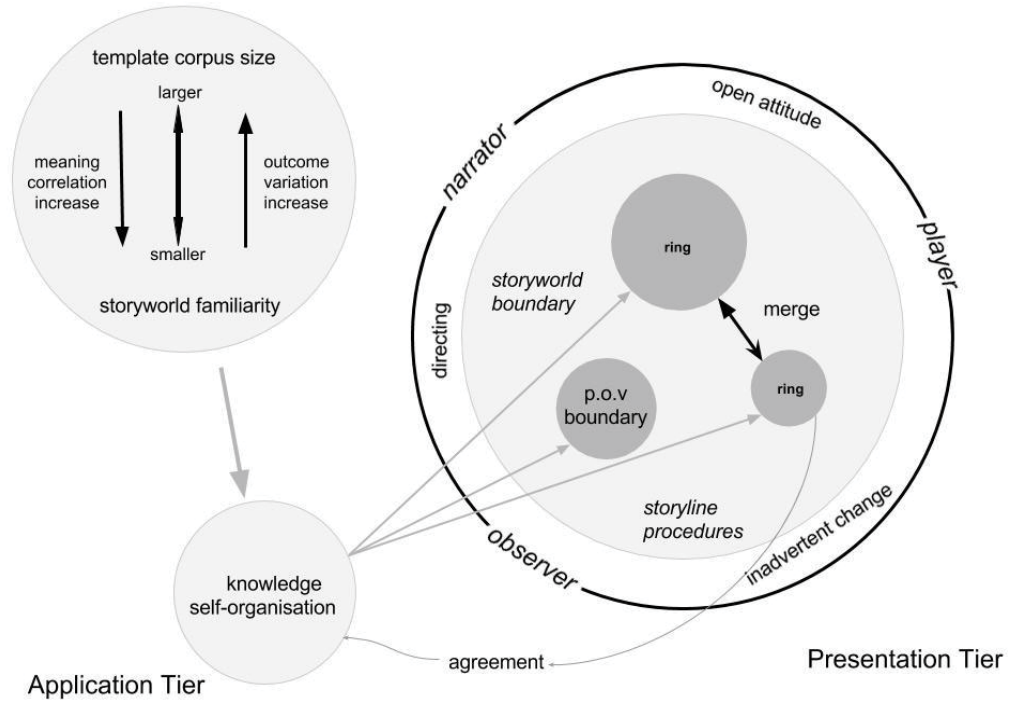


Fig. 43 design features - narrative coherence

6. Conclusions

The following conclusions expand upon the results of the previous chapter and develop recommendations for future research with design for collaboration and natural user interaction. Firstly, a discussion of key findings that will consider the design features and their implications for collaborative narrative systems. The next section details and expands the larger aim of holistic interaction with collaborative systems and natural user interaction. Finally a concluding summary with final thoughts on the thesis contribution.

6.1 Discussion of Key Findings

This thesis posed the research question to understand aspects of design that best support narrative coherence in collaboration with the assistance of natural user interfaces. To answer this question, the software architecture *assimilate* was developed iteratively based on theoretical principles of narrative intelligence, cybernetics and reflective thinking based on participant feedback. Ultimately the complexity of understanding aspects of narrative comprehension as it exists in human nature is by no means dealt within this thesis. However any knowledge or understanding of how narrative operates with regards to collaboration and creativity can only be drawn directly from what was found within the iterative design of the work itself. Since the work is a conglomeration of theoretical and design considerations, narrative coherence was chosen as the central feature that binds these aspects together.

Narrative coherence is identified as the desirable quality to evaluate its suitability as a system that achieves, not only collaborative outcomes, but also meaningful ones. This is defined as shared meaning over a sustained period of time, and a property that clearly represents some form of collaboration. With that said, the design aspects represented in the key findings all show a collaboration took place and this led to an increase shared coherence in some cases.

The key findings included three design features primarily surrounding the operation of the interface mechanics and also the system model that supported it. These are, the interface schemas for narrative comprehension, the conversational model of the system inspired by CT, and the integration of the system design for collaboration. The details and results of these features have been discussed within the previous chapters, and now it remains to discuss why coherence was established in some cases while others not, and the design implications of that.

The introduction of this thesis opened with a foundational concern for all works that deal with interactive digital narrative, the conflict of narrative progression vs player agency and expectation. When narrative is given combinatorial freedom it risks generating meaningless outcomes. If too constrained, it breaks immersion and the engagement with the experience. This design allowed both in an unrestrained environment with the exception of certain boundaries, developed by the mechanics and template media.

It's within these boundaries the resulting design features attempt to mediate these concerns. The system experience can produce meaningless results on many occasions and at other times develops interesting outcomes. The research interest being, how and why do the design features contribute to those times when coherence is best achieved.

To set forward a general argument and concluding statement would be the following. When given the combination of freedom of engagement, a wide context of narrative interpretation coupled with an embodied form of interaction, a particular form of narrative coherence may be established in collaborative system designs. When declaring a form of coherence to be of a particular nature, this alludes to the interpretation of narrative that generally can be made from our everyday construction of it. This describes narrative and our understanding of it to be something that intrinsically part of our identity and growth. As stated throughout this thesis, these metaphorical symbols are interpreted not only from the media present, but also from the behaviour of the interface and most importantly our gestural engagement with it. Within these gestural actions nonverbal conversation forms the basis of the metaphorical interpretation made by the collaborators, and this develops context by which the interface and media can build upon.

The narrative interpretation made by participants is more loosely defined, constructed from a personal identity. Embodied interaction can bring the relationship to the media in a more direct form. With collaboration, this develops a narrative model that is more open to sharing and group recognition. With natural user interface and gestural interaction the immediacy of the engagement organises the narrative context. It brings shared meaning and has a far greater potential to promote collaboration. While context is shaped by the gestural processes and interface mechanics, coherence benefits from presenting a wider context of possibilities within the boundaries of a particular domain, or *StoryWorld*. This was found to be largely reliant on the combination of participant attitudes, the type of content and the constructed boundaries.

When taken together the interface schemas and the collaborative aspects of the design all were tightly integrated with participant attitudes and actions. With participant attitude there was particular desire to be protective of their personal space and boundaries, even when the participants were open to engagement with others. It could be said that with collaboration in general, there are circumstances when aspects of management are needed to deal with issues surrounding interruption, power and control.

While the interface schemas attempt to contain physical boundaries, natural user interaction allows for a greater dimension of freedom and play. This design combines play and narrative intention within a interface action. However whether this intention was pure play or with no real intention, narrative progression was particularly difficult to determine. On occasions pure play would induce some unexpected change for all participants. While interruption is seen as desirable for creative outcomes, on occasions participants were forced to give up control to another who was essentially narrating at the time. With our daily interaction with digital interfaces, control and management of expectation are mandatory

for good user experience. This design differs in that collaborations are seen as a negotiation where compromises are made. These compromises and negotiations give the experience more of a direct feeling that can be associated with a conversational debate or a competitive discussion. Disruption has its place to engender creativity and drama. In this respect the design has quite different concerns and potentially more potency regarding collaborative outcomes.

The mechanics were shown to provide boundaries such that participants could protect and control their own media development or interests. In part the mechanics allowed for certain rules to be established and these boundary mechanisms proved worthwhile for collaboration or role switching. Boundaries were not only delineated by the mechanics, importantly the boundaries of the narrative were also established by the system template corpus. The media corpus established fictional boundaries that contained narratives within particular conceptual domains associated with the corpus, such as a film. A media corpus that contained elements of non-linearity and universal concepts tended to provide greater coherence. This is mainly due to the immediacy that natural user interaction brings to the experience. Narrative concepts that resonated with aspects of personal identity applicable many situations increased collaborative meaning. This became an important aspect of coherence in combination with the process of CT's *agreement* that identifies shared meaning within collaborations as it provided an additional metaphorical boundary. The interface forced this scenario in ways that went beyond the standard CT method and provided a method of establishing an immediate *agreement*, or quite an agreement to disagree, as would be the case in an inadvertent merge operation.

Within the narrative role shifting of *observer*, *player* and *narrator* it was easier to establish if participants were simply observers or not participating for any length of time. The player to narrator dynamic was a case of a certain change in the direction the narrative took. This was only established once a particular action had been recorded. For example, when a participant was dominating a space with *merge*. These three roles best describe the process of how each of the collaborations took place. This does not imply that there could not be two narrators simultaneously operating. Although this was possible it was found that most dominate displays of gestural action were taken in turns, as is the common etiquette found in natural group conversation.

For participant attitude, coherence improves with designs that allow for open conversation with mechanics and other collaborators. Allowing participants to actively engage with the inner processes of the system may assist with developing coherent experiences. Designers can look to these features as clues on developing or modifying participant attitudes to further the collaborative process.

The results found that the design features support collaboration with some form of natural user interaction and only when these features are *combined*. That is none were evaluated in isolation, and such an exercise would be serve no purpose other than to prove its formative aspects are functional. The rationale is that a *holistic* and integrated approach was desirable from the beginning. It is important to establish, that each component of the design was necessary in its approach for a holistic system of interaction.

Meaning the 'natural' engagement with the interface is directly dependent on the model of knowledge contained within the template database. This type of engagement is also communicative to others and useful for collaborative purposes. Within the system's knowledge base this is represented by the *Storyline* or procedural knowledge, and *Storyworld* the declarative. This proved useful in showing how to integrate the knowledge representation of the system with the media and interface components. With CT's model, the primary concern is with group interaction and learning, and it is specifically modelled to store and self-organise group knowledge. This type of knowledge store can only be approached when integrated with real-time process of interaction where knowledge becomes recorded through action. It is important to state that knowledge came directly through action and for this reason it may be considered actionable and more applicable to narrative concerns. While the model showed how *agreement* was achieved through the process of self-organisation, it was not so easy to understand if the 'actionable' knowledge generated was useful within collaborative narrative. However, participants were found to be developing larger correlated meanings with a smaller sets of templates. While this also restricts interesting and varied narrative outcomes the best solutions tended to be from medium sized sets. This is due to segments being replayed, such that each time it appeared during a session, it gave the narrative the particular flavour or 'theme' for the session.

The research question posed by this thesis stated, what aspects of design best support narrative coherence with collaborative semi-autonomous systems with a particular focus on how natural user interfaces assist with this sense-making. This thesis has answered this question by providing a set of design aspects applicable to a system that aims for a holistic form of engagement. The iterative design of the *assimilate* system with a practice based methodology has provided these outcomes through consideration of how natural user interaction develops narrative coherence. A system with an integrated design approach to knowledge development can assist with collaborative sense making and narrative construction. The system's interface is physically responsive, with a set of metaphors that provide an extended conversation supporting narrative intention. The model together with the interface provides a set of defined boundaries that develop collaboration from the smallest of participant intention. Finally, natural user interaction provides the level of engagement to deliver a dynamic experience where participants shift roles working directly with the system processes.

These design aspects aimed for generalisability, such that these features may be applied to other projects with similar aims. However they are closely bound to participant attitude and engagement and would best serve within environments where group dynamics are plentiful with a level of deep engagement. For this reason, these features are not given as prescriptive, however they may point to a particular direction for how such designs may be approached. For this analysis, the following sections will discuss the possible significance of these designs within future research.

6.2 Towards the Design of a Holistic System of Collaborative Interaction

6.2.1 Introduction

This thesis has presented a set of theoretical design features that aim to develop narrative coherence with collaborative environments with natural user interaction. When these features are presented and integrated into a system architecture they all contribute to a larger aim of *holistic* interaction design. The significance of holistic interaction design to HCI research is important, as it places the experience of the participant, or in the case of system presented in this thesis, the experience of the collaboration, as paramount to its desired outcome. New forms of natural user interface (NUI) are increasingly common, such as gesture controlled systems. System design will need to account for participant expectation as new forms of agency, immersion or engagement arise. For the case of collaborative narrative construction and its applicability, this may resolve issues with long standing research problems, namely the generation of coherent narrative.

The *assimilate* system presented with this thesis contributes towards resolving issues of coherence, with the research aim of understanding holistic interaction in collaboration. It begins by understanding how narrative is constructed in our culture and claims that embodied action, through primal action, is how metaphors in narrative accrue and develop. Returning to these cognitive fundamentals demands a significant shift in how we can approach the design of interface with natural user interaction.

The following discussions firstly, develop a set of recommendations in designing for collaboration and NUI, followed by a discussion of system design with cybernetics and semi-autonomy. The recommendations below expand upon the results of the design features within the *assimilate* system with an understanding of how holistic interaction can contribute towards this paradigmatic shift interaction design.

6.2.2 Design For Collaboration With Natural User Interaction

Many discussions within HCI discuss the potential of natural user interaction as a new paradigm of interaction. To achieve this potential, new thinking is required on how interface design can be developed to meet with the level of engagement NUI affordances provide. This thesis has suggested an interface that is specifically designed to be reactive and responsive to NUI devices and affordances. For new modes of engagement require novel approaches to interaction design and a re-interpretation of common metaphors we associate with current forms of HCI. These new metaphors essentially work directly with common embodied actions. The apparent ‘naturalness’ stems from the notion that the immediacy of the interface reactions within the interface map with our physical motions and engagement. These metaphors are easily recognisable since they are considered primal aspects of our embodied cognition. This approach has numerous advantages as outlined within this thesis, including primal recognition that supports collaborative scenarios. One major aspect is the ability for participants to quickly assimilate the

mechanics through minor experimentation or through observation of others. If one metaphor is naturally understood, it systemically follows that others operate on similar principles surrounding a physical model. Often it was found through design iterations that features were suggested by participants after learning basic competency with the mechanics. Usually this was an intuitive guess based on common sense, or the feature was currently under consideration in future iterations. This design practice is important in knowing how individuals may automatically assume a mechanic operates in a particular way, either intuitively or through knowledge of a similar interface mechanism within the system. If a participant without prompting suggests a design feature that was under consideration then this might lead to better iterative design choices being made. While this may seem obvious, on several occasions this happened. For example, keeping a hand still to avoid merges or dragging an item into other participant space. Both are intuitive guesses participants made that fitted within a common sense model of physics designed for the interface. However for others there were jumps to be made based on current metaphors of interaction design. Some participants had issues with aspects of control, including the need for an 'undo' to reset a previous action. Similar critiques on NUI have been discussed by (Norman 2010) where he declares that natural user interaction requires users to learn actions similar to standard interface patterns commonly seen in desktop applications. However this view is based on current expectations that contain features such as the undo pattern. With respect to this particular action, the argument expressed here is to assume that there is nothing inherent to undo. Rather all consequences are subsumed and absorbed into the mechanics and narrative progression. If a correction on performance is to be made through some mishandling of mechanics, this would be delivered by measure of feedback through collaboration with participants directly witnessing consequences of their action. NUI provides an opportunity to develop an intuitive set of affordances that fit within a coherent system of similar interface mechanics. To understand these implications some acknowledgement must be made to how such interactions commonly work in our everyday situations. Arguably, once an act is made in the world, there is no going back with its consequences effecting permanent changes within the environment. If this notion is mirrored within the digital, this develops the potential of greater immersion and deepens the relationship of the participant with the experience. This metaphorical relationship is key to developing the holistic experience that NUI potentially provides.

Natural user interaction generates deep levels of engagement that holistic system designs require. However the approach to the interface design, its affordances and responsiveness to collaborative engagement, requires specific thought to how contextually this operates. In summary the recommendations for designing collaboration with NUIs is to develop interface mechanics with physical models that respond to the immediacy of our actions. This will allow a more systematic focus where interface affordances work in similar ways that are intuitively recognised, as they operate in a similar manner to real world actions and consequences.

6.2.3 Semi-Autonomy - Expressive AI & 2nd order Cybernetics

The interface mechanics developed for the *assimilate* system are described as metaphors for storytelling. They take common actions associated with conversational gestures and bind them within the physical operations of the interface. The storytelling metaphors, such as scope or merge all develop the relationship of the participant to the narrative context. While these drive the fundamental narrative action, beyond this is our capacity to form a unique relationship or *point-of-view* within each narrative sequence. The thesis discussed the relationship participants have with the narrative media and the work. This theoretical viewpoint is best reflected with the notion of Expressive AI (M. Mateas 2001). This theoretical position is a guide for how semi-autonomous narrative systems can operate with enhancement from natural user interaction. Specifically it concerns the relationship of participant to the system processes. This involves the arrangement of processes that develop affordances open to rhetorical interpretation. Rather than directly controlling meaning by placing limits on system variations, an expressive AI system develops 'hooks' or suggestions that allow a wider variation of interpretations to be constructed by participants. The limits of these variations can be made by the work itself, either through constraining metaphors thorough content or through the system's mechanics directly. A general strategy for holistic interaction is to allow this level of freedom in interpretation and accept that participants will make their own judgements accordingly. The *assimilate* system places these constraints through the interface metaphors for storytelling, while allowing the freedom to manipulate with gestural action. Furthermore the interpretive affordances of Expressive AI communicate the narrative concerns of the system corpus through interaction and play. Working together with the interface metaphors, the system's processes are more directly accessible and this extends meaning within the collaborative conversation. Direct access and greater visibility of system process is another important concern with holistic system design. This level of procedural engagement is discussed with Wardrip-Fruin's notion of Expressive Processing (Wardrip-Fruin 2009). This extends the idea that participants will engage at a deeper level by discovering how systems work at a process layer. Designers should allow for this discovery and encourage it by having those processes visible and accessible. That is, the surface level (or interface) is able to show how to manipulate system level processes and engage with them procedurally. The *assimilate* interface creates a digital world that displays a ring with surrounding content. The surrounding content reflects the 'fitness' or weight the system attributes to each media element, each forming an 'island' of focussed context. This is reflective of where the salient concepts are actively being constructed through the system's self-organisation. The interface directly reflects the processes of self-organisation where a visible group conversation is actively agreed upon. This process of actively engaging in *agreement*, is one of Pask's Conversation Theory (CT) (Boyd 2004) tenets. Pask desired a method of formalising knowledge so that group learning could be constructed as a real time collaborative process that acted as a conversation. He understood that modelling a conversation allowed for users to participate more directly with a system because conversation is how we communicate effectively and learn. This insight was ground breaking at the time, and to this day is a design methodology that has yet to be truly realised or understood for its merits. This holistic view attempts to model knowledge that is ideally suitable to group participatory engagement. The *assimilate* interface is designed to specifically

visualise the process of group conversation (inspired by CT) with an understanding of how its system level processes are viewed collaboratively. The CT entailment mesh model includes the notion of *cyclicity*, that allowed each concept network to be navigated and agreed upon depending on participant (learner) viewpoint. Collaborative systems that are able to build upon these conceptual relationships with group interaction can increase coherence and enhance participant relationship to the system level processes.

An integrated architectural approach to interface collaboration and the system process level can develop a greater level of participant engagement. The requirements of knowledge representation at the system process level for holistic interaction are of equal importance to the surface interaction layer. The direct view and manipulation of the system processes will allow for deeper engagement with the narrative context and extend those meanings to the collaborative conversation.

6.3 Concluding Summary

This thesis developed a set of design features applicable to systems of collaborative narrative and presented a direction towards understanding the potential that natural user interaction brings to group engagement. A significant design contribution is the interface schemas for storytelling that were found to support coherence through metaphorical ‘boundaries’, or the physical boundary of the rings. The interface rings that can be scaled, merged or manipulated provided the physical properties for a set of metaphors that were understood by participants. These intuitively conveyed a collaborative narrative space that allowed a personal *point-of-view* in a group conversation. The metaphors mediated this conversation assisting with nonverbal acts by providing metaphorical boundaries, exchanging views and merging concepts together for new outcomes. Through providing freedom of engagement with gestural action, the interface affordances convey intention with the conversation process. This extends the space of narrative meaning within the group conversation and enhance narrative comprehension in the minds of the participants. The design focussed on providing affordances which allow freedom with minimal constraints that provides an immediacy to its feedback with a direct form of manipulation.

The results show that the interface developed collaboration through its mechanics. These produced emergent outcomes where the dynamics of group participation were open to narrative engagement or in some cases pure play. Collaborative engagement ranged from purposeful to the inadvertent. When participant attitudes were focussed on collaboration this produced better results, however there are also cases when participants felt they were disrupted or enforced by the mechanics to merge their concepts. When an outcome was considered unexpected, in general it was met with interest and occasional surprise. In general the element of surprise could be considered a method to generate interesting narratives as supported by the literature. The level of narrative progression is negotiated through the collaboration process itself with the aspects of play developing a continual shift of participant roles that were categorised as *narrator, player or observer*. Consequences of action and choices made are subsumed and incorporated into the system output to mirror how such events would occur in everyday circumstances.

Whether the collaboration was developed through active participation or passive indifference, the interface mechanics at some point responded to any minimal intention set by any participant. For this reason the design encourages collaboration without entirely enforcing it and remains an interesting feature for future collaborative design consideration.

The results found that narrative coherence improves when allowing participants to actively engage directly with the system's inner processes. This is when all the design features are combined and integrated within a software architecture. The combination of the presentation layer (interface) mechanics, the application layer inspired by Pask's CT and the database all form important components of a system that aims for a conversational architecture. The properties of CT were identified and extended for collaboration narrative construction. The theoretical features of CT was shown to be important in understanding how best to integrate natural user interaction to develop coherence and creative novelty in collaboration. Modelling conversation in a formal language ultimately allows deeper engagement when specifically coupled with corresponding interface mechanics. Increasing accessibility to system level processes in a visualised conversational form developed greater awareness of collaborative context and sense-making where *agreement* was identified. This epistemological property of CT remains an interesting consideration for collaborative design visualisation, as it attempts to resolve shared meaning even when no such agreement exists, or an agreement to disagree.

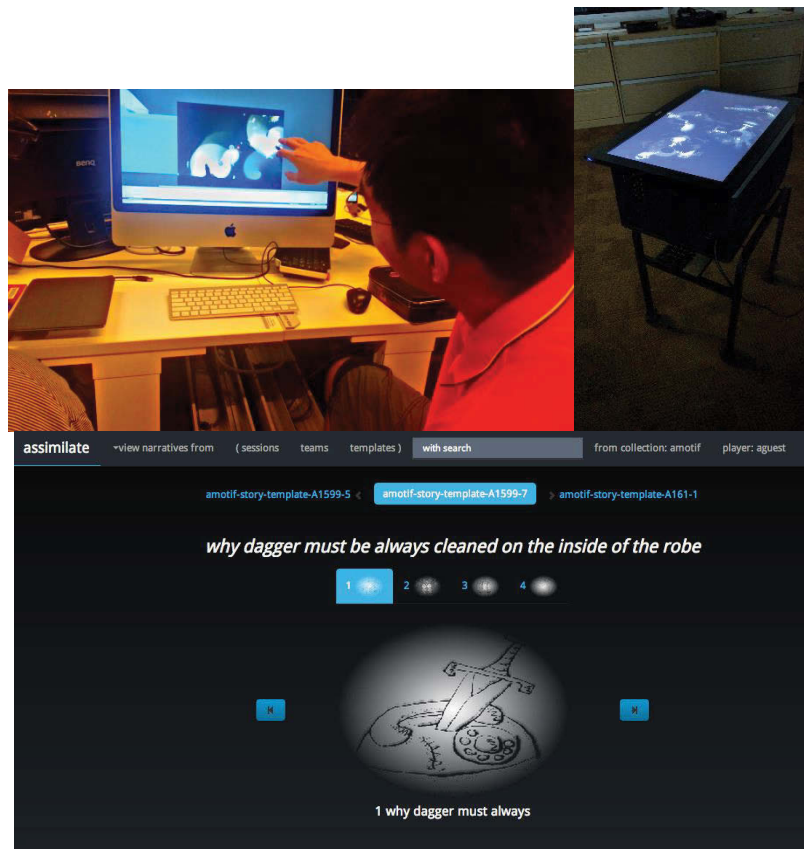
Beyond the design features identified within this thesis, the greater aim is to present them within an integrated software architecture that aimed for a *holistic* design with natural user interaction. Each component identified was shown to be necessary in its approach for a holistic system of interaction. This began with appropriate segmentation of narrative content with universal concepts in a database, through to a system of self-organisation and collaborative sense-making and made visible in a collaborative interface that responds to natural engagement.

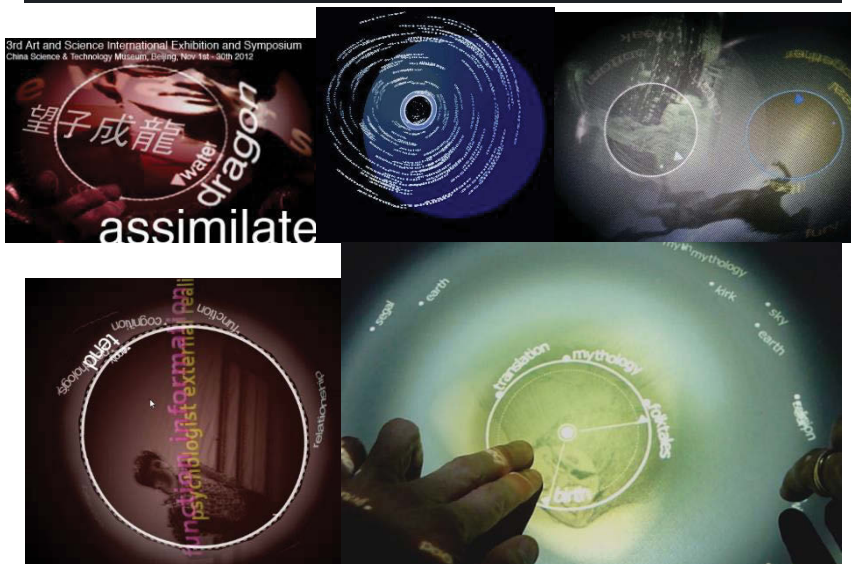
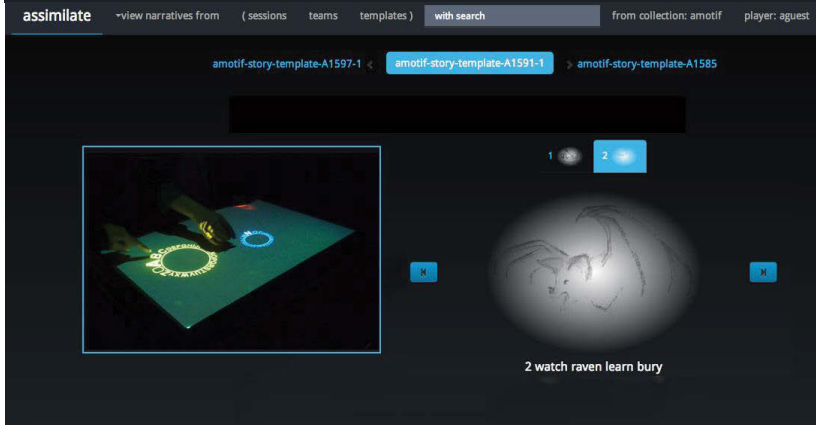
All these design features and natural user interaction contribute to a system that aims towards holistic interaction. Ultimately holistic systems with NUI contain an important part of the future in supporting collaborative narrative creativity and could potentially impact many fields of research in HCI. How designers move towards these goals requires definitive shifts in thinking with regards to current interaction and interface paradigms. An important stage will be to develop new approaches for interaction design to identify and meet with these new challenges. It is the hope that the thesis and the ongoing iterative development of the *assimilate* project will contribute towards this future.

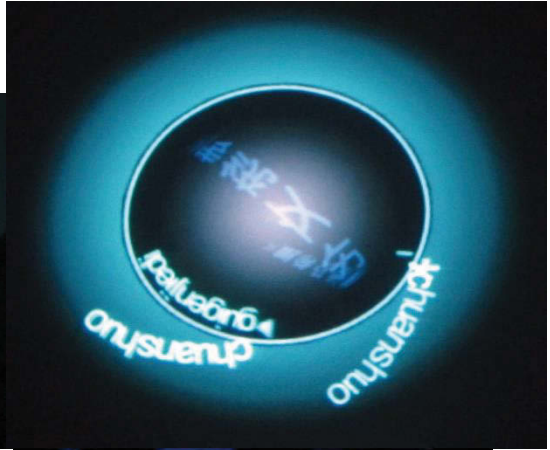
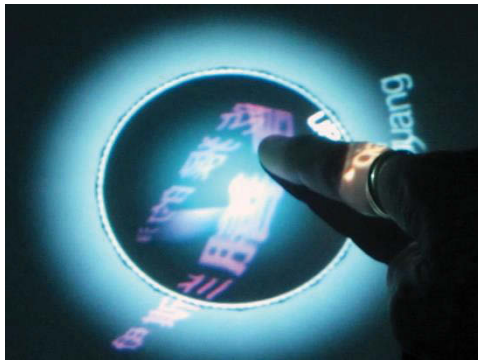
7. Appendix

7.1 Evaluation Images

Images collected from various evaluation sessions.





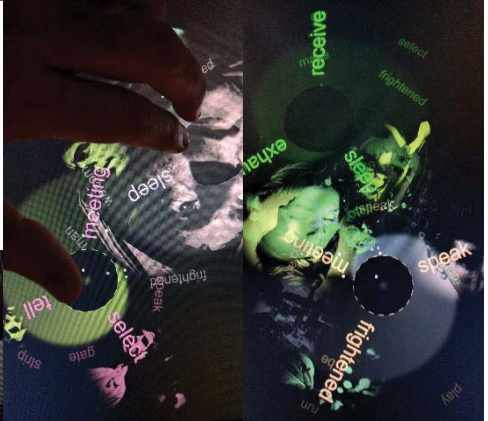


assimilate

alpha screen shot - xmas 03



assimilate



7.2 Questionnaire

assimilate – evaluation 1

Questionnaire for Audience Evaluation

Summary

The work 'assimilate' is being evaluated for audience engagement.

Instructions

When prompted, click anywhere on the surface of the table, and you will be presented with a ring.

You can choose to wait until the experience begins (few seconds) or immediately type in a word, just like a key word in an online search engine.



Questions – Unstructured - Personal

“Using the web interface, please scroll through each video segment and describe your experience in your own words.”

“You spoke more about this video segment in particular, can you tell me what you think the others were doing at the time?”

Questions – Unstructured - Collaborative

“Did the actions of others increase your enjoyment of the experience?”

“Did the actions of others in some way decrease your enjoyment of the experience?”

Questions – Unstructured - Outcomes

“What outcomes if/any did you experience?”

“Did you learn anything from this experience?”

“Did you find the experience valuable in any way?”

“Did anything unexpected happen that might have added to your experience?”

Questions - Structured

Please type in any concepts or words you were thinking about during the experience.

[]

Did you enter this concept into the system or did you observe/hear it during the experience?

Entered it.

Saw another person use it.

Another person mentioned it.

Please type in any concepts or words you thought others were experiencing at the time.

[]

If you typed in a concept(s) initially, write down what you typed in.

7.3 Theme Collections

Participants were asked to circle any of the themes generated by the narrative corpus. This match was done after the interview process. This can be useful to determine if any resonating concepts during the

experience were also matched by the system themes. While this was not as important as the direct experience of the participant, it was useful to understand how the system supported the general experience. The example below is from the La Jetee corpus.

storyobj-characters-common: [woman, crowd, prisoner, survivor, victor, rat, experimenter, head, body, inventor, girl, camp, jailer, people, man, parent, others, child]

storyobj-scenes: [orly, airport, paris]

storyobj-scenes-common: [police, bedroom, laboratory, street, deck]

storyobj-temporal: [morning]

storyobj-actions: [tell, speak, ask, say, meet, welcome, sense, recite, transfer, execute, recognize, explain, invent, aim, go, make, obsess, leave, do, live, stand, have, smile, exist, conceive, return, gather, move, take, be, watch, refuse, play, remember, wonder, set, grant, wake, lie, run, see, forget, suffer, cross, break, give, mention, hear, greet, think, walk, destroy, stay, wait, send, blur, find, change, focus, train, enter, settle, sleep, consider, select, depart, tighten, understand, conduct, know, receive, disappear, point, call, realize, dream, bear, seek, survive, catch, accept, come, strip, fall, become, serve, follow, spare, listen, reach, recoil, counter, rebuild, grow, spy, roll, fill, amaze, pour, lean, grasp, riddle, happen, adjust, distinguish, launch, pacify, believe, seem, crumple, upset, mix, doom, shake, transform, travel, die, mark, summon, wear, stop, begin, continue, push]

-storyobj-themes: [tenth, few, same, several, many, particular, ordinary, grueling, ageless, underground, mad, new, long, close, distant, frozen, possible, unspoken, great, empty, astonishing, powerful, lifeless, different, most, fantastic, last, other, countless, strong, violent, real, able, human, unconscious, ready, uninhabitable, own, silent, happy, armored, reasonable, th, pure, foreign, natural, sudden, memorable, incomprehensible, historical, brief, sole, exhausted, present, frightened, sure, prepared, warm, timeless, perfect, mental]

storyobj-misc-common: [bird, cat, car, meeting, animal, talk, hand, year, day, outbreak, plane, plastic, support, ghost, story, time, material, something, laugh, nothing, death, image, limbo, experiment, guard, wave, garden, meaning, emissary, tool, taste, fate, planet, future, motion, space, thing, hope, name, memory, concern, barrier, terry, ruin, lesson, happiness, museum, zone, scene, plan, series, humanity, roar, subject, moment, test, guinea, outcome, wall, trail, request, childhood, medicine, loophole, mean, essential, trunk, necklace, way, ease, disappointment, path, pig, tender, energy, slag, radioactivity, phenomenon, place, fixation, passage, survival, surprise, excitement, face, grave, kingdom, truth, trust, fact, part, fear, scientist, encounter, redwood, peacetime, marking, control, explanation, scar, cry, land, sophism, sun, setting, question, vanishes, adult, unit, landmark, success, rescue, tree, expectation, industry, form, director, lift, bait, start, ground, escape, cloth, date, starting, mind, end, observation, visitor, fascination, race, shot, disguise, combat, power, confession, shape, food, word, madness, attempt, glass, gesture, gate, shock, riches]

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