

humaine

D8c

Description of potential exemplars: WP 8

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The place of this report within HUMAINE

The HUMAINE Technical Annex identifies a common pattern that is followed by most of the project's workpackages:

The measure of success will be the ability to generate a piece of work in each of the areas which exemplifies how a key problem in the area can be solved in a principled way; and which also demonstrates how work focused on that area can integrate with work focused on the other areas. We call these pieces of work *exemplars*. The exact form of an exemplar is not prespecified: it may be a working system, but it might also be a well-developed design, or a representational system, or a method for user-centred design. (p 4)

To that end, each thematic group will work out a proposal for common action, embodied in one or more exemplars to be built during the second half of the funding period (p.16)

The process will begin with production by each thematic group of a review of key concepts achievements and problems in its thematic area; and drawn from the review, an assessment of the key development goals in the area. This review and assessment will be circulated to the whole network for discussion and comment, aimed both at building understanding of basic issues across areas, and at identifying the choices of goal that would be most likely let the different groups achieve complementary developments. That consultation phase will provide the basis for deliverables in month 11, which describe in some detail a few alternatives that might realistically be chosen as exemplars in each area, and their linkages to issues in other thematic areas. A decision and planning period will follow, involving consultation within and between thematic areas, leading to presentations at the second plenary conference, which will describe a single exemplar that has been chosen for development in each area, and the way work on the exemplar will be divided across institutions. The remainder of the project will be absorbed in developing the chosen exemplar. (p. 21)

The review and assessment documents were delivered in May, and the consultation phase has been ongoing since, using several channels, notably e-mail exchanges moderated by the coordinator; meetings of workpackage leaders by teleconferencing; meetings between workpackage representatives attending the WP4 workshop and the Summer School; and a consultation meeting of WP leaders in Paris on October 29th & 30th.

This deliverable is one of the group arising from the consultation phase, whose function is defined as to 'describe in some detail a few alternatives that might realistically be chosen as exemplars in each area'. In general, we believe that we have progressed more quickly than we have expected, and that the alternatives described here are close to the ones that should be pursued. What remains to be completed is largely detailed planning. Given the intricacy of the network, that is not a trivial task.

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1 Brief overview of the workpackage, the exemplar proposal, and relevant resources

WP8 is mainly concerned with output in the sense of inducing emotions in the audience. Yet, on the dimension general/specific there is clear consensus that our work cannot be one that accommodates or models all forms of emotional communication. Rather we shall focus on some relevant areas for having an impact on concrete application scenarios.

The Workpackage has a specific computational aspect. Its aims are to help understand some of the critical issues for building persuasive, or otherwise emotion-inducing computational, systems, and to develop environments that help experimenting specific concepts, try limited realizations that can be demonstrated as proofs of concepts in view of a novel class of systems.

The WP 8 exemplar is based on work on one common element where a concrete applied scenario and evaluation methodologies are delineated and on two themes that aggregate all the development activities in WP8: 1) basic persuasive communication and 2) creativity for persuasive communication. The approach is constructive and is concerned with investigating – through theory development, component design, mock-ups and WOZ experiments, and some limited implemented prototypes– particular aspects of persuasive and creative communication in the applied scenario.

1.1 The field covered by the workpackage

The area covered by this workpackage is described in the Technical Annex, particularly in Section 6.2, and in more depth in the review and assessment document for the workpackage. We summarise the area here partly so that the deliverable can be read as a stand-alone document, and partly to draw attention to changes of emphasis that have taken place during the first period of HUMAINE.

1.1.1 Conception of the area before HUMAINE began

There are many potential applications of emotion-oriented systems where the goal is not to manipulate or match emotion as such, but to use emotion-related means as a way of achieving pragmatic ends – for instance, ensuring that a person is receptive to information, or motivated to carry out a task. There is a long-established literature on these issues in social psychology, and recently the technological community has become increasingly interested in the ways that these effects may be used. For instance, several researches have suggested that the user's productivity and performance is enhanced by the use of emotionally coloured embodied agents. Users spend more time interacting with an agent with a stern face than one with a neutral expression. The challenge in this thematic area is to understand the way emotion-related means can be used to enhance systems' ability to communicate and persuade.

1.1.2 The current conception

WP8 is mainly concerned with output in the sense of inducing emotions in the audience. Our conception is coherent with the initial one, better focus and down to earth.

The current state of the art does not allow to build sophisticated practical systems and the term persuasion is sometimes used without meaning the capacity of behaving flexibly, or creatively on the part of the system. No doubt that future intelligent interfaces will add dynamicity and they will have contextual goals to pursue. They may aim at inducing the user - or in general the audience - to perform some actions in the real world. They will have to take into account the “social environment”, exploit the situational context, and value emotional aspects in communication. On the other hand there is a creativity dimension, for a message to attract interest (e.g. humour) and computers will have a role in assisting humans creativeness with their own autonomous capabilities.

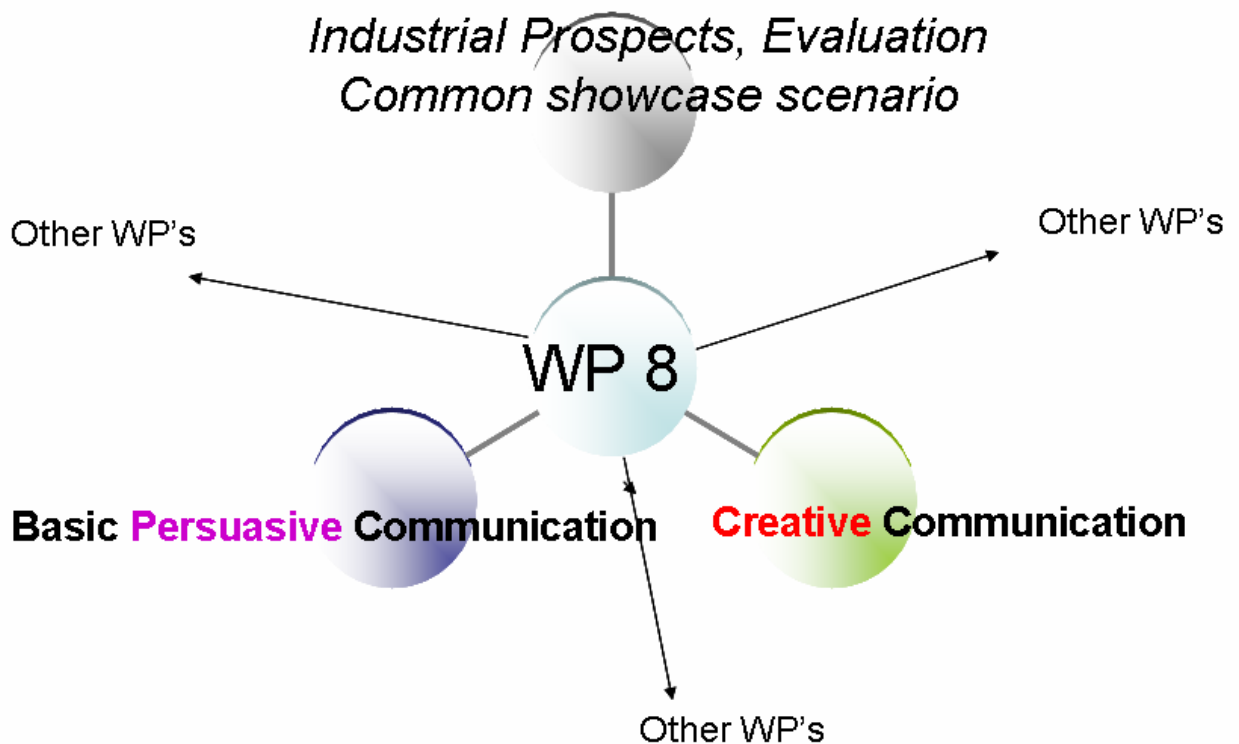
WP 8 will focus on some relevant areas that can have an impact on concrete application scenarios.

1.2 The exemplar proposal

Following the consultation period, the exemplar proposed for WP8 is titled *Persuasive Communication Environment*

This title has been chosen to stress various ideas: a) there is a whole set of means for realizing a persuasive communicative goal, and they contribute to defining our existing landscape, for good or for bad; b) we are talking about computational environments; c) we emphasize the realization of experimental settings, where some aspects are not yet under full control of a system, but shared with a human that may still have to accept the system suggestions or adapt them.

1.2.1 The elements of the exemplar



The exemplar is traversed by **one common theme**, an element whose role is to determine the industrial prospect of the area of emotions in persuasive and creative communication, define an overall scenario for anchoring activities to a concrete challenge, define methodologies for evaluation in agreement with WP9 and perform resulting user and evaluation studies.

We are currently working at the definition of a promotion campaign for some concept of social value, or for a cultural theme, realised through a number of different technology-based means. The idea is that the campaign exploits various forms of technology, broadcasting-oriented, individual-oriented, interactive and so on.

Two elements are concerned with the development activity.

Element 1: Basic persuasive communication, including: Persuasion Models, Integrated model of emotion and politeness, A mobile persuasive storytelling guide, Gaze and eyes for persuasion

Element 2: Creativity for communication, including: Creative verbal humour, False emotions in true lies, Music for persuasion

1) Basic Persuasive Communication

Persuasion Models. Persuasion is a pervading phenomenon in human communication. It has been defined in many different, formal, ways, from action to behaviour inducement. While lots of theory have been proposed to explain different aspects of persuasion, only few have hardly tried to categorize all of its facets in a comprehensive and, most of all, computational way. The goal of this part of element 1 is to develop and test theories about persuasion, both in monological and dialogical interactions, that are not purely based on “rational” argumentation. These theories will possibly lead to the development of two prototypes (one for monological interaction, and one for dialogical interaction).

ECA's are one of the expressive means we intend to adopt, albeit not the only one. The development of ECA's is the task of WP6, but Gaze and Eyes for persuasion in ECA's is specific to this WP and will also be part of this exemplar theme.

A component dealing with output production in a dialogic system for an ECA will also be further defined in this context.

An integrated Model of Emotion and Politeness. We will design and implement a conversational model that integrates a social theory of politeness with a cognitive theory of emotions. To test our model, we will provide an interface to a concrete animated agent (e.g. the Greta Agent developed by Catherine Pelachaud) that is able to vary its communication tactics based upon the emotional state of the user.

A mobile persuasive story-telling guide. Development of a synthetic personality with its own attitudes and affective engagement with the guide domain. An affective model and expressive behaviour is here seen as a key to the development of such a personality, in the sense of what constitutes the distinguishing features of a particular person, the externally evident aspects of the character or behaviour of a person. We want to develop an augmented mobile environment consisting of 2 virtual agents possessing contrasting personalities, having different perspectives about the surrounding environment. The user will be able to hear different versions of the same event or places depending on the profile of the virtual storyteller. The goal is to investigate the impact of perceived personality and expressive behaviour on the knowledge a user acquires from the guide both on retention and on the position adopted by the user, that is, the extent to which they are persuaded of the guide's world view. A participative emergent narrative. Interactive narrative approaches have to deal with a narrative paradox in which the structures required for satisfying narrative appear to conflict with the interactional freedom of the user. Emergent narrative tackles this problem by decomposing narrative hierarchically and maintaining a hypothetical plot at the highest level of abstraction which adapts to the lower-level actions of interacting characters. It deals with the persuasive elements in interaction which support the ‘willing suspension of disbelief’ by a participating user. Our goal is to construct a graphical interactive narrative in which actions emerges from the interaction between characters within a more abstract narrative framework

adapting to those interactions. Story management will be incorporated both as a top-level mechanism modeling exogenous variables and by distribution within the architecture of synthetic characters. Affective state will be used as one of the metrics of engagement.

2) Creativity for Persuasive Communication

Creative Humour Testbed. An environment for some forms of humorous creativity, in which the user (for instance a creative advertiser) is able to manipulate and play with the creative and affective potentialities of natural language, proposed by a competent agent. Linguistic units are proposed, modified and expanded by the system according to computational humour techniques. A possible model of the receiver based on his/her personality, cognitive and affective state, can be included. Thus the resulting messages are tuned to the mental state of the final addressee and capable of influencing him or her. For example, this tool could be useful for the creation of advertisements, news headlines and personalised banners for e-commerce. Similarly, such a tool could be effectively employed in intelligent tutoring (or edutainment) systems. Emotions generated by computational humour can provide a good support for promoting memorisation and attention.

False emotions in true lies. In human-human communication, emotions are the number-one topic that people lie about and studies show that up to 30% of social interaction longer than 10 minutes contain such deceptions. Endowing technical systems like embodied conversational agents with the ability to detect, represent, generate and/or show emotions, it is thus indispensable to investigate the crucial questions how to handle false emotional expressions from the user and how and when to create false emotional expressions in the ECA. As a first showcase we are developing the system GAMBLE. This is a small game of dice where one of the game partners is substituted by the Greta Agent (developed by Catherine Pelachaud and colleagues (see also WP6)). To win this game of dice it is necessary to deceive the other players and to detect such attempts by the other players. This showcase will allow us to investigate in a principled way (i) if users react at all to clues that are described in the literature to indicate a lie when an ECA shows these clues, and (ii) if this is the case, how they react to and interpret these clues, e.g., as a malfunction of the system, as an affront, or as a useful feature that makes the interaction more engaging. Music will also be an important element in the creativity for persuasive communication theme and its possible integration will be studied.

1.2.2 The ways in which the exemplar depends on other Workpackages

Here is a list of dependencies proposed by WP 8 and an evaluation of problems and solutions for moving forward.

“←” means imported to WP 8, “→” means exported from WP 8.

- WP 3

← functions of emotion in persuasion, i.e. the process of emotion induction and its role in inducing action (WP3 will see if it can provide input)

← personality and humor (WP3 will see if it can provide input)

← data and theories about collective emotions induced through mass communication (Most likely WP3 will not be able to provide input)

← → mapping of meaning

Work on affective lexical knowledge base performed at IRST can be relevant and receive input

- WP 4

← Gaze as an indicator of emotion

← Emotion recognition from linguistic (text) analysis.

No competences are in WP4 for that; it was decided to develop the work within WP 8 (ITC-irst).

← Prosody, gestures and facial expression plug-in tool .

If anything close to this becomes available in the course of the project, it will be tentatively experimented with for getting user's feedback.

- WP 5

→ corpus on polite interactions

From University of Augsburg

→ corpus on interactions with an ECA

From University of Paris 8

← corpus on Human/Human persuasive interactions

- WP 6

← ECA's

↔ specification for humour and persuasion in representation language

- WP 7

← Models of emotion activation and emotional decision making

- WP 9

↔ Evaluation criteria for persuasive and creative msgs

- WP 10

→ Ethical issues in persuasion by an artificial agent (individual and mass communication)

1.2.3 Proposed final output

a) establishment of a European backbone community working on computational and applied aspects of emotions in communication;

b) insight regarding the development of a new class of interfaces, expressed in a variety of documents;

c) some (limited) prototypes as showcases of persuasive and creative communication in an overall common scenario;

- d) evaluation of different persuasive approaches;
- e) a book, with contributions by all major involved groups.

1.3 Related resources

In D 8a, “Report on Basic Cues and Open Research Topics in Communication and Emotions” we have defined a number of relevant terms and concepts for our analysis that are preparatory for this document. We refer to sections in that document.

Persuasion: theories, proposed definition and systematization, related concepts (e.g. argumentation, social influence, etc.) (§1). Working systems and computational issues (§2). Issues related to evaluation of persuasiveness of a system (§10)

Politeness (§5): positive and negative face, face threatening acts (FTAs), use and theories of politeness. Strategies and implementation

Storytelling (§7): different approaches to narrative modelling in theories and working systems, the “narrative paradox”

Gaze: the importance of gaze in social interaction and as a communicative mean. A lexicon of gaze behaviour (§6).

Humour: Cognitive, social, and psychoanalytical theories of humour. Humour complexity and aspects related to creativity (§3). Issues related to evaluation of humorousness of a system (§3 and 10)

Lies: faking emotions, clues of deception in human face and body. Lies detection: handling false emotional expressions from the user. Lies generation: creating false ECA emotional expressions, when and why (§4).

Music: modelling issues regarding emotional content of music (§8) and possible creative uses for persuasive communication

Bibliography for section 3 can be found in D8a.

2 Rationale for the exemplar proposal

The exemplar proposal represents a choice to follow a particular line of development rather than others that are possible (or might seem possible to the outsider). The key reasons for making this particular choice are as follows.

2.1 Distinctive features of the approach proposed

We can synthesise our approach as follows:

- We take a computationally-oriented, constructive approach, as far as the limited resources allow.
- We are focused mainly on emotion-inducing output.
- We are guided by a unifying applied scenario in cooperation with our industrial partner
- Our groups form a community, share ideas, components and entertain a continuous discussion on the themes.
- We focus on a significant set of topics and components but by no means our activity covers all the broad topic of communication and emotions

Already now computers are meant to take a variety of roles as persuaders, including roles of influence that traditionally were filled by teachers, coaches, clergy, therapists, doctors, and salespeople, among others. E-commerce is one of the most obvious fields of application. This for the moment does not reflect human capability of persuading in context and of including a dimension of creativity and surprise in communication.

Future intelligent interfaces will add dynamicity and they will have contextual goals to pursue. They may aim at inducing the user - or in general the audience - to perform some actions in the real world. They will have to take into account the “social environment”, exploit the situational context, and value emotional aspects in communication.

Some foreseeable scenarios of this kind are: dynamic advertisement, preventive medicine, social action. In all these scenarios rational reasoning is not enough. For intention adoption often what really matters is not only the content but the overall impact of the communication.

The aim of our research is to provide the interface with the capability of reasoning on the effectiveness of the message, as well as on the high-level goals and content. To this end, we have focused on persuasion mechanisms.

Emotion induction of all forms, through a number of possible means, is still far from being flexible and effective, if present at all in existing prototypical systems. There is still a lot of work to do to develop general communicative capacities of artificial agents. We want to focus, with a constructive aim, on persuasive and creative elements of affective communication in HCI. We organise the first element under the title “Basic Persuasive Communication” and the second under the title “Creativity for persuasive communication”. We plan to have a single applied scenario for evaluating different facets of these elements: a promotion campaign for some concept of social value, or for a cultural theme. The idea is that the campaign exploits various forms of technology, broadcasting-oriented, individual-oriented, interactive and so on.

Persuasion is a key aspect to develop more engaging conversational agents since it is primarily a pervasive phenomenon in human communication. We are dealing with different definitions of persuasion, focus on foundational aspects in the development of intelligent agents, and intend to showcase some initial realizations that demonstrate achieved progress.

For Natural Language output, we will investigate strategies for monological and dialogical interaction. For multimodal output, we will investigate the use of ECAs for emotion displaying. Two interesting cases will be the study of emotion dissimulation (creation of false emotional expression) and the social and persuasive uses of gaze. On the social side of persuasion particular attention will be also posed to the use of politeness in different power-relation and emotional circumstances. Another concern for persuasive multimodal generation will be the creative uses of music for emotional content conveying. To explore the persuasive possibilities of other types of “involving” experiences, like narrative, we include the study of a story telling guide. Last but not least a fundamental aspect that will be investigated is automatic production of creative verbal humour, as a resource for producing persuasive communication. Humour has an application-oriented role realised through a surprise effect, the overcoming of inner censors and consequent release of energy. It provokes an immediate effect, including a positive attitude and attention on the part of the audience and a long lasting memory effect. Both can be important for persuasion.

We shall start from a scenario defined with our industrial partner and monitor research advancement with the prospect of adding a strategic resource to future systems. Insight of key problems, development of theories and of working prototypes will be complemented with appropriate methodologies to evaluate persuasiveness and creativity, also in collaboration with WP9.

2.2 Rationale for emphasising this approach

The topic is broad and we cannot solve all possible problems within HUMAINE. There is a problem of complexity and a problem of insufficient formalisation of several aspects in order to build *generic* systems. On the other hand there is *continuum* between systems that yield “persuasive” nonflexible messages and systems that may add some degree of flexibility and creativeness. We think that addressing specific topics with a constructive approach is necessary to convince industries of the potential and realism of our field. Advancements within the lifespan of the project must be perceivable and the path for a phase subsequent to the project must be cast. We contrast this with a more speculative approach.

2.3 Rationale for subdividing the task

After various discussions and meetings we have come to the conclusion that the best approach is the structure we have given to the exemplar. We have one exemplar with one common inspirational and evaluation oriented element and two aggregating elements to develop knowledge and components that address different facets of the area. A specific role can thus be given to all major players in the WP.

2.4 Measures taken to ensure coherence across subtasks

1) the common scenario and evaluation element; 2) basic persuasive communication and creative for persuasive communication elements guarantee shared views and common components, 3) a continuous discussion of themes, problems and proposed solutions.

2.5 Measures taken to ensure coherence with other exemplars

WP 8 deals specifically with output. It relates strictly to WP 6 (and to WP 5) as far as ECA's, one of the expressive means envisaged, are concerned. Interaction with WP 9 will be assured through the definition of methodology and possibly the experiment of one evaluation case. Active participation in WP 10, also for starting modelling ethical behaviour of persuasive artificial agents is also intended. Other specific potential points of interaction are listed in *1.2.2*.

3 Technical aspects of the program of research

3.1 Element 1: Basic Persuasive Communication

3.1.1 Issues that are largely resolved

Persuasion Models

Historically, lots of definitions of persuasion have been given. Most of them have a common core that addresses *methodologies aiming at changing, by means of communication, the mental state of the receiver.*¹ But, these definitions, despite the common core, are quite different one from another.

There are related concept (e.g. argumentation) that has been largely investigated, even in computational fields. Intuitively, when talking about the relation between argumentation and persuasion, a dichotomy between these two concepts is put forward. The former is seen as a process that involves “rational elements”, while the second uses a-rational elements like emotions. In our view, instead, argumentation is a resource for persuasion.

There are several dimensions of persuasion that can be used for structuring broad areas of study (Audience specific vs. universal, Monological vs. dialogical, Domain specific vs. universal, Just language vs. multimodality) and there are different elements playing a role in persuasion processes (the cognitive state of the participants, their social relations, their emotional state, the context in which the interaction takes place).

Fundamental is to study how emotions can be used to affect decision making. There are four dimensions to be considered:

1. The current emotional state of persuadee (how it affects strategy selection by persuader)
2. The emotional state expressed by persuader (which emotion persuader has to display in order to maximize the persuasive force of the message)
3. The emotional state possibly produced on persuadee through the message (the induced emotional state could be non desirable and in general it must be taken into consideration for the subsequent interaction)
4. The current emotional state of persuader (how it affects his strategy selection)

There is an increasing research interest in HCI on providing systems with deep reasoning capabilities on persuasive features. There are systems, or researches, that are moving toward this direction and classify them according to the definitions of persuasion pointed out in the d8a:

- 1) *Systems focusing on the communicative goal of persuasion*: STOP is one of the most well known systems for behaviour inducement that exploited persuasion [Reiter *et al.*, 03a; Reiter *et al.*, 03b]. STOP is (mainly) a natural language generation system, employed for real human settings. Its aim is to induce users to stop smoking.
- 2) *Systems focusing on argumentative aspects of persuasion*: some systems, such as the one proposed in [Zukerman *et al.*, 00], use argumentation strategies in the generation of persuasive messages. Zukerman is concerned with the abstract form of the unfolding of the argument. In general, though, logical reasoning is just one resource to support persuasion.

¹ See for example wordnet definition: “the act of persuading (or attempting to persuade); communication intended to induce belief or action”

Existing computational model of persuasion (e.g. [Grasso et al., 00], [Walton et al., 02] and [Zuckerman et al., 99]) are built on the seminal work developed by linguists, philosophers and cognitive psychologists: Toulmin [Toulmin, 58] first of all, but also Perelman and Olbrechts-Tyteca [Perelman et al., 69] to mention only a few.

The study of these theories/systems enlightened the limits of applying a purely logical reasoning to this domain and the need, on one side, of considering uncertainty [Zuckerman *et al.*, 00] and on the other side of introducing argumentation schemes more refined than logical *modus ponens* [Walton, 00].

3) *Systems focusing on the “how” of persuasion*: One of the more recent subjects of interest in this trend of research on natural argumentation concerns widening the persuasion modes from considering 'rational' or 'cognitive' arguments to appealing to values and emotional states ([Sillince *et al.*, 91; Grasso *et al.*, 00; Guerini *et al.*, 03; Poggi, 04]). Carofiglio and de Rosis [Carofiglio & de Rosis, 03] also focus on emotions as a core element for affective message generation. Their model, since their main concern is dialogical argumentation, uses one persuasive strategy per time.

4) *Systems focusing on multimodal aspects of persuasion*: many systems using ECAs address the multimodal aspects of persuasion, but, in general, more on the perceptual interface side than the planning one (in which persuasion plays a major role).

Finally, it should also be noted that there are commercial tools claiming to have persuasive aims, but they have only hardwired persuasive features. These are the main focus of “Captology”, the term introduced by Fogg [Fogg, 02] with reference to persuasive technologies.

Integrated model of emotion and politeness

According to [Brown & Levinson, 87], politeness strategies are communicative devices for redressing the threats inherent in verbal and nonverbal utterances. Positive politeness aims at protecting the individual’s desire to be evaluated positively. Negative politeness accounts for the individual’s desire to act free from impositions.

[Walker et al, 97] have shown how the Brown and Levinson approach may be successfully applied to the implementation of simulated dialogues between conversational agents.

There is no doubt that the perceived threat resulting from a speech act heavily depends on the user’s emotional state. Furthermore, knowledge about the causes for the user’s emotions should guide the selection of politeness strategies. Consequently, the emotional state is a factor that emerges during the interaction and dynamically influences the ongoing dialogue.

Recent approaches focus on the situational factors that should be considered when selecting specific strategies to mitigate face threats.

[Johnson et al, 04] question whether there is an absolute ranking of politeness strategies as the theory by Brown and Levinson indicates and suggest to treat positive and negative politeness separately.

[André et al, 04] focus on the causes for the user’s emotions as an important situational factor. To consider the user’s emotions when deciding between several communicative strategies, André and colleagues integrate a cognitive model of emotions with a theory of politeness.

[Porayska-Pomsta & Mellish, 04] make use of Brown’s Levinson’s model in order to motivate linguistic variations of a natural language generator. To model the bidirectional dependencies between the autonomy and approval values on the one hand and the situational factors on the other hand, the authors employed Bayesian networks.

While the approaches above concentrate on linguistic strategies to portray politeness in

dialogue systems, other approaches concentrate on the oppression of emotions as a sign of politeness.

[Prendinger & Ishizuka, 01] consider Brown's and Levinson's social variables distance and power in order to control emotional displays of agents. The question of whether to show an emotion or not has also been handled by [Pelachaud et al, 02].

Another question is, how users respond to systems that simulate behaviours of politeness common in human-human dialogue.

[Bickmore & Cassell, 00] describe how smalltalk is utilized to build up common ground between an embodied conversational agent and the user based on an extension of Brown's and Levinson's theory of politeness.

[Alexandris & Fotinea, 04] conducted an empirical study for a Speech Technology application that was developed for customer service in Modern Greek.

A mobile persuasive storytelling guide

It is apparent that narrative theories have been heavily influenced by the idea that narrative must be authored [16,1,17,2,3,4]. The distinction between spectator (passive) and user (active) implies that a differentiation must be made between authorial and interactive approaches to narrative. On one hand, narrative is seen as an artefact that can be studied, involving non-interactive spectators, whereas, on the other hand, it could be perceived as the dynamic process resulting from the interaction between characters and its impact on the user (the 'Storification' process).

Some groups are trying to obtain methods and mechanisms to automatically generate narratives (this is the plot based approach), while others are more concentrated on trying to obtain believable characters (character based approach). A few try to reconcile both approaches.

A wide number of different types of systems are being built by researchers, many with different purposes. In [29, 30, 35, 34, 32, 36] the objective is virtual drama. Computer based storytelling is also a flourishing area [33] bound to the concept of a narrator.

The granularity of the information used to construct stories is a determinant factor. In general, the larger the granules used to build with, the easier it is to build. The smaller the granule, the more precise and smooth the building can be.

As pointed out in [37], from an artificial intelligence point of view, two different approaches have been taken to try to solve the narrative generation problem. Works trying to apply Propp's ideas to generate narrative are using a knowledge based approach, while those giving every character autonomy in order to get an emergent narrative from their interactions are using a behavior based approach.

From a more linguistic point of view, as pointed out in [21], previous work on story generation has generally taken one of two approaches: structuralist or transformationalist.

Much of the work dealing with the first global set of approaches, that is, these which obtain more predefined stories, try to order story pieces into a coherent whole story. This work relies on the assumption that narrative has well-defined high-level structures. In this sense, the theories of Polti [27], Propp [23], Aaren, Thompson [19] and Branigan [6] are specially interesting.

Brooks [37] uses Branigan's structures as a general guide in developing a framework for structuring metalinear stories. In particular he designed AgentStories [37], a software tool consisting of a set of environments for authoring pieces of stories, authoring the relationships

between the many story pieces, and for designing an abstract narrative structure for sequencing those pieces.

On the other hand, an example of the works dealing with the second global set of approaches (that is, these which obtain more surprising stories) is the Oz project [9]. In order to build characters that have the “illusion of life”, they will need to have broad capabilities to interact with complex environments.

Terminal Time [40] was a system that combined historical events, ideological rhetoric, familiar forms of TV documentary, consumer polls and artificial intelligence algorithms to create hybrid cinematic experiences for mass audiences.

The Kyoto Tour Guide [38], was a project aiming to develop an agent integrated in an on-line 3D website tour, a digital version of Kyoto. It explored ways to make an agent's narrative effectively adaptive to different groups who take the tour, like an expert human tour guide.

MAKEBELIEVE [21] is a story generation agent that generated short fictional text of 5 to 20 lines when the user supplied the first line of the story.

In [20], Dautenhahn explores how theories on autobiographical memory can be applied to a virtual environment (VE).

Gaze and eyes for persuasion

Gaze awareness and eye contact are extremely important during face-to-face interactions. Not only does gaze help to direct practical tasks, such as turn-taking in conversation, but it also conveys a range of social signs. Experiments drawn attention to the persuasive nature of gaze.

Garau et al. investigated the importance of eye gaze in humanoid avatars representing people engaged in conversation. Also Colburn et al. [CCD00] have investigated the use of eye gaze in avatars. As Garau et al. notes, these results suggest that an informed eye gaze model motivates participants to pay more attention to the avatar during conversation.

Cassell and Thorisson [CT99], conducted a number of studies on user interaction with autonomous human-like agents. Importantly, they demonstrated that non-verbal communication behaviours, such as gaze, are very important for conversational plausibility.

Cassell and Vilhj'almsson [CV99] present the BodyChat system, which automates the animation of communicative behaviours based on context analysis and discourse theory. It allows users to communicate via a text interface while the avatars automatically animate with appropriate gaze, salutations, turn taking and facial expressions. Cassell et al. [CVB01] have also presented BEAT, a toolkit for the animation of expressive behaviours. The toolkit automatically selects appropriate gestures, facial expressions and so on. The toolkit's gaze generator is based on an algorithm from Cassell and Torres [CTP99] that accounts for the relationship of gaze behaviour to turn-taking and information structure.

Chopra-Khullar [CK99] presents a computational framework for generating realtime visual attention behaviour in a simulated human agent based on observations from psychology, human factors and computer vision.

Gillies [Gil01] presents a simulation of what a character is attending to in the environment in order to generate, among other behaviours, navigation and eye movements. Attending behaviours are generated in an object-centric manner; ray-casting is used for occlusion testing and retinal images are not considered. Objects contain basic properties that are defined as comms and agents. They also contain features that represent more abstract concepts such as beauty and interest.

Various systems [BES97; CAS94; CTP99; THO02; CAS99] simulate face-to-face conversation with a user. Such systems combine several modules for the perception and generation of audio and visual signals with modules for the analysis and recognition of nonverbal signals such as facial expressions, eye and hand movements. This audio and visual information is used to emulate turn-taking protocols [Bes97; CPBSABDPS94; CTP99; Tho02; CAS99], to call for the user's attention [WRLKT96] and to indicate objects of interest in the conversation [LSCVF00; Tho97; Bes97].

On the other hand [CCD00, FOMSH02, LBB02] use a statistical model to drive eye movements. Most models presented so far concentrate either on the communicative aspects of gaze or on a statistical model. We will propose a method that combines both approaches to get a more natural as well as meaningful gaze behavior.

Poggi et al [PPR00] have proposed a method to build a lexicon of gaze. A lexicon is constituted of (meaning, signal) pairs. On the signal side, Poggi et al [PPR00] have defined a set of parameters to describe eye movement. On the meaning side, each element is described following the taxonomy of communicative functions as proposed by Isabella Poggi [PogTA].

Poggi et al [PPR00] propose a gaze model based on the communicative functions model defined by Poggi [PogTA]. This model predicts what should be the value of gaze in order to have a given meaning in a given conversational context. To embed this model into temporal considerations as well as to compensate somehow missing factors in this gaze model (such as social and culture aspects) Pelachaud and Bilvi [PB03] have developed a statistical model. The previously developed model is used to compute what should be the communicative gaze behavior; the gaze behavior outputted by this model is then probabilistically modified. The gaze model comprises two main steps:

1. *Communicative prediction*: First it applies the communicative function model as introduced in (Poggi, to appear) to compute the gaze model so as to convey a given meaning.
2. *Statistical prediction*: The second step is to compute the final gaze behavior using a statistical model and considering information such as: what is the gaze behavior for the Speaker (S) and the Listener (L) that was computed in step one of our algorithm, in which gaze behavior S and L were previously, the durations of the current gaze of S and of L.

3.1.2 Issues that remain to be resolved

Persuasion Models

Our long term aim is to develop a framework which will be the basis for building effective and usable tools for investigating the role of emotions in the persuasion process for HCI both in a monological and in a dialogical perspective. Given the limited resources available, our contribution to the WP8 exemplar will mainly consist in the *development of a theory* and in a *well-developed design of critical parts of a prototype* (for instance, in the form of a mock-up). Many challenges are to be taken into consideration.

- a. **Integrated models** of emotion manipulation and beliefs and goal induction are necessary. The approach will emphasize BDI&E (belief-desire-intention-emotions) agents and models of how intentions and commitments are produced (and induced) in such agents. This will lead to the development of mental models for persuader and persuadee.
- b. **Mental models** In formulating a persuasive message, emotions are generally viewed as internal mental states representing evaluative reactions to events, agents or objects (according to the OCC model, by Ortony, Clore e Collins). We will study how to extend mental states of the two interlocutors with a representation of (active and activable) emotional states. Models for representing 'induction of emotions' in the User (at which we will work in the scope of WP7) will be integrated in the dialog simulation exemplar, as well as a linguistic emotion recognition component at which we will work in the scope of WP4. In the context of WP8, we will, in particular, highlight the importance of employing cognitive models in persuasive affective dialogs between BDI&E Agents in order to

evaluate several methodological solutions. This has to do with the *construction of a double model of reasoning, that concurs to manage several sources of uncertainty which are intrinsic to the process*. The double model will contain (i) a component for representing first order beliefs, desires, intentions and emotions (what the persuaders believes) and (ii) a component for representing second order beliefs about the interlocutor.

- c. **Persuasion strategies representation** To simulate natural argumentation and (emotional) persuasion we need to define new methods for representing knowledge, for reasoning on it and for generating natural language and multimodal messages (both in monological and dialogical situations). An appropriate formalism will be proposed, for representing and manipulating information about the structure of arguments (for example, Walton's argumentation schemes and also different kinds of cause-effect reasoning). The dialogical exemplar will include a method for verifying the validity of every scheme according to the truth value or the degree of certainty/uncertainty of available data.
- d. **Measurements models:** To handle the problem of uncertainty, to model the concept of effectiveness of a message and to foster the process of choosing the best strategy to be used at every interaction, we need to furnish models of measurement of the strength of persuasive strategies, and of other related concepts such as: argumentation strength [Sillince & Minors, 91], probative weight [Walton, 00], dialectical relevance [Walton, 99] and impact [Zukerman *et al.*, 99; Zukerman, 01].
- e. **Contribution to an emotional persuasion theory.** Persuasive messages contain various elements, one of the most critical of which is language. Employed language and its efficacy depends, at the same time, on the state of mind of the persuader and of the persuadee. According to Wegman's theory, in arguing about a topic, concepts which are congruent with the persuader's primary reaction will be more easily accessible by the interlocutor. Several studies showed that the order of items in the argumentation process, their valence and the complexity of the overall message are influenced by emotional involvement of the persuader. Other authors (for example, Sillince), showed how activation of various kinds of emotions may be exploited to increase the power of a persuasion process in the interlocutor. Our contribution will be translate these theories into workable models, which define how the two factors of adaptation to emotions may be combined to produce messages of variable strength.
- f. **Adaptation of the persuasion strategy** Given the double model, the system will employ it to select a persuasive communicative act tailored to its interlocutor, in a way which is coherent with its own mental state. This will be done by accessing a library of alternatives, represented according the methodological solution defined under Persuasion strategies representation. In principle, every alternative in the library represents a persuasive strategy which is dynamically 'patched' to the second-order mental state. If several alternatives exist, they are all enclosed by noisy functional dependence. The model will be employed to investigate the effects of evidences on some alternative strategies (with a *what-if* type of reasoning). In particular, we aim at investigating which is the change in the interlocutor feeling, as a consequence of a given communicative act. In other words, the model we wish to include in the exemplar should enable to reason on the expected emotional impact of a communicative act on the mental state of the interlocutor. Combining the ability to reason about the expected emotional impact of a candidate communicative act with knowledge about the cognitive state of the interlocutor allows the persuader to select the best strategy for influencing the interlocutor. The amount and type of information provided by the communicative act can therefore be calibrated to the attitude of the interlocutors towards their behaviour: their knowledge of what a 'correct' behaviour is, their belief that their behaviour is (partially or fully) incorrect, their intention to change it (in part or fully), their definition of a plan to achieve this goal (Prochaska *et al.*, 1992).
- g. **Recognizing the effect of a persuasion attempt on the interlocutor** (This requires attempts) to guess the most probable explanation of some kind of 'evidence' provided by the interlocutor (a facial expression, a natural language formulation of a 'move' etc). The

model we wish to build should enable the system to integrate recognition of the emotional state of the user with an interpretation of the reasons of this state, according to the (known or presumed) facts in its knowledge base.

- h. **Counter-argumentation** Argumentation (and also persuasion) is often modeled in the framework of ‘defeasible reasoning’. Therefore, our exemplar for dialogical interaction will include the simulation of situations in which, given an (emotional or non emotional) argument formulated by the System, the user may make several kinds of objections (what Walton calls ‘critical questions’) and in which, depending on the kind of objection the user makes, several categories of recovery strategies are proposed, again, by the system.
- i. **Multimodality.** The realization of a persuasion message requires the expression in a communication language. In most approaches natural language is the main modality, but there is an increasing research on the role that could be played by music, kinetic typography, ECA’s, and so on.
- j. **Evaluation.** Persuasive systems need to be evaluated. That is, it is not sufficient that they are theoretically sound: they also have to be effective with real users. Evaluation is not straightforward at all: specific evaluation methodologies have to be defined.
- k. **Indirect aspects** like attention and memorisation can affect the effectiveness of persuasive messages. E.g. if the attention of the user is low, or there are key concepts persuader wants to stress, then persuadee’s attention has to be focused or enhanced by using various means. Among them we consider of high importance the use of irony or affectively “coloured” terms. Similar considerations can be made about memorisation. When possible, we will implement working prototypes of some modules and will evaluate the effectiveness of alternative strategies or solutions with appropriate methods.

Integrated model of emotion and politeness

Even though the theory by Brown and Levinson seems to provide a promising basis for the implementation of politeness strategies, it also creates a number of problems, see [Knapp & Daly, 03] for a more detailed discussion. In particular, the following challenges need to be addressed:

- a. **Selection between different behaviours of politeness.** First of all, the linear ordering of politeness strategies from direct over approval-oriented and autonomy-oriented to off-record may lead to inconsistencies. Indeed, a number of studies revealed that autonomy-oriented strategies are not always conceived as more polite than approval-oriented strategies. Furthermore, speakers tend to use several combinations of politeness strategies within one utterance. Even a dialogue act that is aimed at sustaining negative face of the hearer can be employed in an approval-oriented strategy. It is also questionable whether indirectness and vagueness are actually useful means to redress face threats. In some cases, vague system utterances might even increase the user’s negative emotional state (instead of mitigating it).
- b. **Multimodal politeness strategies.** There is sparse information on non-verbal means related to politeness strategies. Previous work has concentrated for the most part on the linguistic aspects of FTAs, i.e., on verbal means to deliver and redress FTAs. But FTAs are inherently multi-modal. Dressing up a threat in a joke usually only works if the speaker shows in his whole appearance (facial expression, body posture) that he is telling a joke. Otherwise the threat might be even more severe than it is.
- c. **Relationship between the user’s emotional state and his or her perception of politeness.** First studies indicate that the appropriate use of theories of politeness may have a positive influence on the user’s emotional state. Nevertheless, it is still rather unclear which strategies of politeness to employ in which context. Furthermore, standardized measurements are missing for determining whether the coded strategies

actually lead to an improved perception of the interaction experience.

- d. **Cultural-specific aspects of politeness.** Finally, it is a great challenge to adapt politeness behaviours to a specific culture. For instance, people in individualistic cultures seem to display their emotions more overtly which is usually perceived as impolite in collectivist cultures. On the contrary, people from collectivist cultures tend to suppress emotions that most likely conflict with the mood of the group.

Mobile persuasive storytelling guides and narration

- a. **Reconciling narrative structure with interactivity.** The key theoretical challenge faced by work in this area is to find solutions to the ‘narrative paradox’ [18]. While interactivity supposes user freedom to choose actions and interactions, narrative requires structure (classically, a beginning a middle and an end) which clashes badly with this freedom. The paradox is felt most acutely in participative narrative in which the user plays a role in creating a story, and least acutely where the user is made the author (thus merging author and spectator). Intermediate solutions include the use of pre-defined plan-trees for characters [29], the development of very large numbers of alternative story fragments [8], branching narratives, episodic interaction using concepts like Boal’s ‘Spectactors’ [5] and character-based emergent narrative [28].
- b. **Handling the integrative effects.** A further set of engineering challenges lies in the integrative effect of narrative systems, which frequently demand virtual characters with affective architectures (WP7) and expressive behaviour (WP6), and means of detecting the affective engagement of the user in the narrative process (WP4). In a mobile application resource limitations make the integrative problem particularly acute.
- c. **Affective selection.** If a story-teller is to persuade the user, it must both deploy its own affective system (memory, action-selection) to the construction of a compelling narrative, and make use of empathy to anticipate the impact of the narrative and monitor this impact.
- d. **Evaluation.** There are also challenging issues of evaluation (WP9). Simple usability metrics miss the point of such a system which tries to draw on the affective and imaginative engagement of the user and the impact of the guide’s personality.
- e. **User response detection.** As with all applications in which an affective loop is being created, there are basic technological problems on the side of capturing the user’s response (WP4) – this is clear in the limitations of the current state-of-the-art in speech recognition and text-to-speech systems.

Gaze and eyes for persuasion

Gaze awareness and eye contact are extremely important in establishing persuasive relations with another during face-to-face interactions. The human infant is very sensitive to the eyes of other humans, responding even to similar stimuli, such as circles that look like eyes; infants also notice the gaze direction of another when as young as 3 months old. Such importance is not lost on adults: business people will sometimes travel thousands of miles to communicate “face-to-face”. We propose an investigation of the effects of various eye and gaze attributes on the persuasive abilities of an Embodied Conversational Agent (ECA), which will entail research in the following key areas:

- a. **Awareness and persuasion.** A fundamental way in which an ECA should be persuasive is to persuade the human user that they are ‘aware’ of them and paying attention to them. It is probable that a visual agent that is not believable in this regard will also fail to be persuasive at other levels.
- b. **Low-level parameters relating to the eyes and gaze.** These include mutual and averted gaze durations, pupil dilation and eye-head ratios. We endeavor to establish how changes to one or more of these parameters may be interpreted by a human user in the context of a persuasive agent using test environments. For example, an ECA that blinks a lot and

makes a lot of saccadic eye movements may be perceived as being uncertain or untrustworthy, and therefore fail to be persuasive.

- c. **Goals and supergoals.** To enable a wider scope in this area, we also concern ourselves with how persuasion relates to the goals of an ECA and may itself be considered a high-level ‘supergoal’ of a given ECA. The elaboration of a goals module blueprint that accounts for such supergoals, as well as lower level goals with appropriate mappings onto low-level parameters, is relevant to our work.

This work also fits in well with indirect aspects of persuasion, such as attention, which we are also studying in coordination with WP6.

3.2 Element 2: Creativity for Persuasive Communication

3.2.1 Issues that are largely resolved

Creative verbal humour testbed

Humor has been studied since the ancient times and in the Twentieth Century saw a lot of developments. Theories can be classified along three main groups:

1. *Cognitive*, where the main concepts are incongruity and contrast and the focus is on the stimulus.
2. *Social*, where the main concepts are superiority, hostility, derision, disparagement and the focus is on interpersonal effects.
3. *Psychoanalytical*, where the main concepts are relief, release, liberation, sublimation, and the focus is on the audiences reaction.

The field of computational verbal humor was initiated by Victor Raskin (1985). His first approach relies on the concept of script, a large chunk of information, typically commonsense stereotypical information, evoked by a word or word combination.

An important attempt to create a computational humour prototype is the work of Binsted and Ritchie (1997). They have devised a formal model of the semantic and syntactic regularities underlying some of the simplest types of punning riddles. A punning riddle is a question-answer riddle that uses phonological ambiguity. The three main strategies used to create phonological ambiguity are syllable substitution, word substitution and metathesis.

Many computational approaches try to deal with the incongruity theory at various level of refinement [Köstler, 64; Raskin, 85; Attardo, 94]. The incongruity theory focuses on the element of surprise. It states that humour is created out of a conflict between what is expected and what actually occurs in the joke. This accounts for the most obvious features of a large part of humour phenomena: ambiguity or double meaning. A relevant aspect to be taken into account is how humour is appreciated by different individuals. Personality studies regarding this specific theme give important indications Ruch (2002).

An important working prototype mainly based on incongruity theories was developed in the context of the EU project HAHAcronym (IST-2000-30039) [Stock & Strapparava, 2003]. HAHAcronym prototype was a system that makes fun of existing acronyms, or, starting from concepts provided by the user, produces a new acronym, constrained to be a word of the given language. And, of course, it had to be funny.

Specific workshops concerned with Computational Humour have taken place in recent years and have drawn together most of the community active in the field. The proceedings of the most comprehensive events are [Holstijn & Nijholt, 96] and [Stock, Strapparava & Nijholt 02]. Ritchie (2001) has published a survey of the state of the art in the field.

False emotions in true lies

According to [Ekman, 92], there are at least four ways in which facial expressions may vary if they accompany lies and deceptions: microexpressions, masks, timing, asymmetry.

- 1 *Micro-expressions*: A false emotion is displayed but the felt emotion is unconsciously expressed for the fraction of a second.
- 2 *Masks*: The felt emotion (e.g., disgust) is masked by a not corresponding facial expression, in general by a smile. Usually, it reveals at least in part the original emotion.
- 3 *Timing*: Facial expressions accompanying true emotions do not last for a very long time. Thus, the longer an expression lasts the more likely it is that it is accompanying a lie.
- 4 *Asymmetry*: Creating facial expressions voluntarily like it occurs during lying and deceiving, those expressions tend to be displayed in an asymmetrical way.

Most studied cues to lies or deception so far are visual. In the voice, however, hints to deceptive speech can also be found as lying causes emotional arousal in the liar. But in speech, we have to distinguish between ‘able’ liars and ‘bad liars’ [Anolli & Ciceri, 97].

In the area of human-computer interfaces, especially in the area of embodied conversational agents, lies and deception are nearly non-existing topics. [McKenzie et al, 03] describe deceiving agents as training partners for the military domain (check point). Castelfranchi and Poggi developed a theory of deception in communication [Castelfranchi & Poggi, 93], which helps in modeling the decision to deceive and the choice of the deception strategy which is appropriate in a given context. This theory grounded prototyping of a deception modeling tool in which both the ‘deceiver’ and the ‘receiver of the message’ are modeled [Carofiglio et al, 01; de Rosis et al, 03a]. [Carofiglio et al, 01] model some deceptive strategies by belief networks that may be incorporated into conversational agents. More literature can be found in the area of conversational systems [Lee & Wilks, 97] and of multi-agent systems where different strategies of deception and their effects are examined. [Ward & Hexmoor, 03] as well as [Castelfranchi et al, 98] both present multi-agent simulations as testbeds for examining the effects, benefits as well as damages, of different forms of deception on the interactions of agents.

Besides work on the simulation of deceptive agents, there are various attempts to model virtual agents that deliberately oppress or express emotions since the social or pedagogical situation requires it. The Cosmo system, where the agent’s pedagogical goals drive the selection and sequencing of emotive behaviors, is one example [Lester et al, 00]. Pelachaud and colleagues developed an agent that deliberately plans whether to exhibit a certain emotion or not [de Rosis et al, 03b]. A similar approach has been developed by Prendinger and colleagues who considered the social variables distance and power in order to control emotional displays of agents [Prendinger & Ishizuka, 03].

Other researchers have been concentrating on the opposite problem – namely how to identify the user “true” emotions (as opposed to those deliberately expressed). Most of these approaches focus on the analysis of bio signals

The recognition of emotions in [Bosma & André, 04] is based on physiological user input. Integration of the multiple input modalities, i.e., language and emotion, is achieved by extending the approach of [Johnston & Bangalore, 00] who employ finite-state transducers for this task.

Music for persuasion

One of the key problems is how to describe what music conveys emotionally. The traditional ‘basic emotion’ categories are still widely used (eg Juslin & Laukka, 2003), but their lack of subtlety is perhaps even more striking in the context of music than elsewhere. An attraction of the approach is that the same techniques have been used to capture the emotional content of both faces and voices (Cowie et al, 2001). Hence they offer the prospect of integrating research on music and emotion into the wider field of emotion research.

Modern approaches to dimensional representation originated with Schlossberg (1954), who used statistical techniques to show that most of the emotional content of faces can be captured by considering them as points in a space with two dimensions.

3.2.2 Issues that remain to be resolved

Creative verbal humour testbed

A deep modelling of humour in all of its facets is not something for the near future; the phenomena are very complex, humour is one of the most sophisticated forms of human intelligence. Yet some steps can be followed to achieve results. Here below we raise a number of issues for the next period of development.

- a. **Effects of humour.** To what extent is it possible to use the power of humour for influencing the affective and cognitive state of the receiver? In which contexts is it useful to provoke surprise or to change the focus of attention?
- b. **Affective language.** How can emotion expressions contribute to the realization of humorous effects? In particular, a key theme concerns the automated development of affectively coloured expressions in the overall creation of humorous messages.
- c. **Evaluative language.** In humorous advertising, the goal is the generation of humorous messages containing a positive evaluation of the target. How integrate evaluative language for the communication of attitudes and opinions? Stripping away clichés and commonplaces, and stressing their inconsistency, people can be more open to new ideas and points of view.
- d. **Creative humour as a collaborative activity.** Creative production of humorous expression is a high valued capability and professionals are hired to perform it. A research theme focuses on a new type of human-computer interaction in which creative humorous output is the collaboration of human and artificial creativity.
- e. **Common sense knowledge for humour.** In which ways is it possible to play with human expectations to generate surprise and then hilarity? Instrumental for this issue is to collect a wide amount of common sense linguistic resources and to manipulate the stereotypical knowledge in order to infringe the expectations of the potential user, and trigger a humorous effect. Knowledge resources must include familiar expressions such as proverbs, idioms, clichés, quotations, movie titles, etc. NLP techniques have to be explored so to produce humorous variations of familiar expressions: assonances and rhymes, wordplays, reasoning on lexical and conceptual terms, etc. Dimensions of opposition and other forms of humorous incongruity will have to be specifically studied.

False emotions in true lies

Work done so far on lies and deception in agents focuses on the effect of false information that is exchanged to achieve a predefined goal. In everyday life this is not the general case in which deception is applied. People tend to lie primarily about their emotions. Thus, endowing a computational system with the ability to detect or show emotions it is inevitable to regard this aspect of human communication giving rise to two main research questions: (a) How to handle false emotional expressions from the user and (b) How and when to create false ECA emotional expressions (because it is expected).

Approaches so far handled deception as an ability of the agent to achieve its goals in a complex environment or to make the user believe a false statement is true. These are more or less anti-social lies, in that they are employed to solely benefit the liar. By far more frequent in human communication are so called social lies, e.g., about one's emotions. Social lies are employed to protect the face of others or the relationship to others. They are highly situation and context dependent. Social lies are more fuzzy in that they are not necessarily employed to achieve a specific well-defined goal but are more or less used to protect others or the relationship with others.

- a. **Handling false emotional expressions from the user.** Recognition of lies or more subtle forms of deception of the user requires processing expression signs and interpreting them

in the light of the context in which communication occurs. Cognitive models of the user and representation of context features help in reducing the high level of uncertainty in this recognition process. The same kind of models might help in deciding *whether* to generate a false emotional expression in the ECA before actually generating it. Because social lies are employed in specific situations to protect others or the relationship to others, recognizing the current situation aids detecting false emotional expressions from the user. Depending on the interaction context, the system has to react to the user's false emotional reaction. This is one of the main challenges consists of integrating context representations and cognitive user models to assess the situation at hand and trigger an appropriate reaction like ignore, update user model, or elaborate.

- b. **Creating false ECA emotional expressions.** Creating false emotional expressions in ECAs can be divided into two subparts, (i) Decision when to create a false emotional expression, and (ii) How to realize a false emotional expression. As mentioned before, approaches so far dealt with the strategic value of deception to achieve the agent's goals. In the case of creating false emotional expressions the agent again will have to assess the current interaction situation to decide on an appropriate emotional reaction. But dealing with ECAs does not only require to solve the question how to strategically or in a socially appropriate way create false emotional expressions but also the question if and how the agent's lying attempt influences the generation of appropriate nonverbal behaviours like facial expressions or body movements. To create an agent that employs social lies in a believable way, the agent's nonverbal behaviour has to be influenced by the fact that it is lying and thus the agent has to exhibit these clues to deceit. To test users interpretation of faked facial expressions in an agent that adhere to Ekman's clues, we devised the GAMBLE testbed that allows us to investigate in a principled way (i) if users react at all to clues that are described in the literature to indicate a lie when an ECA exhibits these clues, and (ii) if this is the case, how they react to and interpret these clues, e.g., as a malfunction of the system, as an affront, or as a useful feature that makes the interaction more engaging. Moreover, by controlling the agent's expressive behaviour we will be able to examine how different expressive behaviours of the agent exert an influence on the user's affective states.

We aim at showing that dimensional representation based on activation and evaluation can be used to capture broad aspects of the emotional content of music.

The dimensional representations are obtained using a tool called FeelTrace, which has been developed at Queen's University, Belfast. FeelTrace allows users to describe emotional experiences using a combination of emotion labels and colour which were chosen to give users a continuous input device capable of recording emotional interpretations easily and reliably (Cowie, et. al, 2000).

Two variants of the dimensional representation were considered. The Cartesian variant assumes that the activation and evaluation axes represent psychologically distinct dimensions. The second variant, the circumplex, has been advocated by many authors, notably James Russell (1997). That suggests an emotion's position in that space can be represented using polar co-ordinates, with the distance between the central point and a particular emotion's location representing the intensity of the emotion, and the angle between it and an arbitrarily chosen axis expressing what we have called emotional orientation.

FeelTrace translates those ideas into a computer program that allows users to track the perceived emotional content of a stimulus as it occurs over time.

The system includes additional features which help to stabilise responses.

The results of a test conducted with this system provide a preliminary indication that dimensional representation provides a reasonably powerful way of expressing the emotional

content of music, not only in homogeneous pieces, but also within pieces that change in their emotional tone. Carrying out the experiments highlights deficiencies in the details of the approach, though. Feeltracing speech, one rarely feels that the absence of a ‘power/control’ dimension is a major problem. Owens (2001) has developed a version of Feltrace which allows users to work in all three dimensions, but it is ergonomically awkward. Also, some very common musical effects cry out for a representation involving two emotional centres rather than one – typically one centre associated with sadness, the other with intense pleasure (‘sweet sorrow’, in Shakespeare’s phrase).

These observations highlight one of the reasons for thinking that music should be taken very seriously in the context of research on emotion and communication. Music seems somehow to achieve a purity and intensity of emotional expression that language, cluttered with semantics and syntax, rarely does. Hence questions about the nature of the feeling it evokes seem to be sharper, and it may pay dividends to study them before re-engaging with the cluttered world of language.

3.3 Common theme

3.3.1 Issues that are largely resolved

Applied Scenario

Computers are taking on a variety of roles as persuaders, including roles of influence that traditionally were filled by teachers, coaches, clergy, therapists, doctors, and salespeople, among others [Foggs,03]. With the arrival of the Internet and new technologies, we are experiencing more and more a real invasion of the virtual into our living habits and this tendency is growing also because the computer is everywhere: Personal and office computer, Personal Digital Assistant, Mobile phone, interactive booth, television, Cars assistant, home automation. Just to give an example of this increasing evolution, the e-commerce represented 95,7 billions of dollars in US in 2003 and expect to grow to 229,8 billions of dollars in 2008 who represents a +140% variation [Forester Research,03].

Despite this impressive growth, the user is not totally satisfied. Regarding the e-commerce, still in the US, the figures show that the average visitor/buyer is only 3,4% [Forrester Research,02] and about 50% of the buyers stop their transactions on the web and this proportion doesn’t reduce: 45,9 % in Q2 2003 and 57% in Q2 2004 [Double Click, 04].

These figures are disappointing and show a real issue in the Man-Machine interaction comparing with the real life. The reasons are numerous: The most frequently cited barriers to online shopping include product pricing (cited by 77 percent of individuals), potential return hassles (67 percent), concerns about credit card security (65 percent), and personal privacy issues such as worries about junk e-mail (58 percent). Difficulties in navigating a merchant's site were cited as a barrier by 35 percent of individuals who have yet to make an online purchase, and 48 percent of those who have purchased something online. One-in-four buyers also complained about the amount of time it took to receive their orders [Intermarket Group,00] and the online shopper needs to be very persuasive to satisfy his client and convert him in a real buyer.

The analogy with the real life is interesting. The way people interact with technology is the way they interact with each other [Picard, 04]. The user, in front of the computer, reacts like he does with a human. If we stay with the e-commerce example, the buyer enters a shop with the purpose to satisfy her needs or simply her curiosity. A vendor plays the role of companion: he will analyse her needs, interpret them and orient the client in the shop, reassuring and consulting her as well as satisfying her needs. The goal of the shop owner is to sell and to establish a relationship of trust between its clients and its brand.

The e-commerce is not the only application where persuasion is necessary and obvious to satisfy its goal and, if trustworthy is a key factor for e-commerce applications, other persuasive factors are more benefits for others. Virtually, we will establish relationships with emissaries of commercial sites, vendors in online shops, professors in e-Learning environments, nurses and doctors on health sites, or just off-line office companions, speakers for institutions or communities that want to get into contact with us.

Evaluation

While past research almost totally ignored the question of how the expression of emotions by the source of a message affects persuasion, much research documented the role that the emotions of the receiver of a persuasive message play in his/her persuasion. In particular, research documented how the elicitation of particular emotions in the receiver can enhance persuasion and under what conditions such an enhancement is achieved (e.g., Coulter & Pinto, 95; Leventhal, 70). For example, under certain condition fear can be effective in achieving persuasion in contexts such as the prevention of behaviors that put health at risk [Hovland, Janis, & Kelley, 53].

The way emotions potentially affect message processing in the receiver is best captured by the Elaboration Likelihood Model (ELM) suggested by Petty & Cacioppo (86). The ELM model claims that there are two routes to persuasion: the central route and the peripheral route. When the receiver is persuaded via the central route, change of attitude is longer lasting and more immune to further contradicting persuasive attempts. If, however, the receiver is unable and/or unmotivated to process the information contained in the message, persuasion can still occur via the peripheral route were simple cues related to the message or the messenger can affect persuasion.

According to the ELM, any aspect of the communication can serve one or more functions in persuasion. It can be perceived as an argument, and/or it can be perceived as a peripheral cue and/or it can affect the depth of processing of the message by the receiver. In considering the question of how emotions can affect persuasion otherwise than by directly being linked with a certain attitude, the ELM suggests the possibility that emotions will affect persuasion by determining the level of processing. In accordance with this claim, research indicates that emotions arising in receivers often affect persuasion indirectly by affecting a receiver's level of processing of the incoming message. For example, research has shown that anger sometimes reduces the ability of receivers to think carefully about a message [Bodenhausen, Sheppard, & Kramer, 94].

3.3.2 Issues that remain to be resolved

Applied Scenario for the industrial partner

E-commerce is not the only market where persuasion using ECAs is necessary, and ECA's are not the only solution. But let us start from ECA's. Here are examples of the main applications where the ECAs market exists and few directions of how they can be persuasive regarding application fields:

Sales/Marketing : By 2005, major vendors of CRM suites will either acquire virtual agent technology or partner with best-in-class vendors to enhance their collaborative CRM capabilities across sales, marketing, and service products [Hickernell, 02]. AVIS has launched in early 2002 a website dedicated to its partners who wished to offer on-line car-booking services.

Support and assistance: It is one of the most obvious use for an ECA where the character needs to be very helpful. Laura was hired by EDF for a long-term contract in December 2002 in order to give advice and provide suggestions for maximizing home comfort though effective use of electricity on the site www.mamaison.edf.fr. Laura gives advice on how to

consume electricity more intelligently. Laura uses a lot of different ways to be persuasive like changing clothes depending of the room she is, playing quiz with the user, and so on.

External communication: Organisations with existing personalities embedded in their brands should consider extending branded personalities to Virtual Agents to exploit brand affinity among customers. Even if an organisation doesn't have its own branded personality, it's possible to communicate by its representation. This is illustrated by the case of Packard Bell who, in February 2002, launched their new line of computers, namely Internet Dre@m M@chine, together with Netissimo and Intel. For promotion, they wrote an interactive script played by Capt'n Surf, a sort of superhero who praises the power of the machine.

E-Learning: Virtual instructors have the role to bridge the gap between asynchronous and synchronous) learning systems. The goal is not just to provide applications using just a cyber teacher but several studies show that that several characters can be more persuasive. Software can help students learn better when a virtual teacher is accompanied by a virtual student. The virtual student creates an illusion of a classroom setting, in which the real student can receive praise from both the teacher and a virtual peer [Nass, 04].

Internal communication: That's the main market Cantoche actually develops. Customers see with the avatar a very good cyber employee in order to motivate the real ones. The company Valeo hired the character Kiny to persuade the employees to use the new Intranet web site. Kiny is integrated in the computers and appears to promote a new Intranet features. Kiny uses several gestures and an adaptive dialog with humor in order to create user's emotions. Once the user opens the Intranet site, Kiny serves the role of assistant (tour guide portal, contextual help at the user request,...) and messenger (broadcasts messages and announcements).

As described above, an ECA (or more) can create a lot of emotions for the users and can be very persuasive for the user depending of the application. In this WP, Cantoche wants to continue working with the Humaine group by experienced different ways of persuasions depending of the situation. We have entered an era of persuasive technology, of interactive computing systems designed to change people's attitudes and behaviors. [Fogg,03] but we need to find the best way to do it and avoid the failures. For instance, the interaction with a supposedly realistic humanoid character still leaves the human viewer with a more eerie and disturbing impression than a corresponding interaction with an intentionally non-realistic character [Picard,01]. An animated paperclip winking at you every time you click on it to go away is analogue at a person who insists on winking at you every time you ask them to leave your office [Picard,01]. Persuasion can be on different ways but needs to be used with care. The risk is to give the user the impression to be manipulated and it's not the goal.

Cantoche would like to work on a promotion campaign scenario that includes the presence of an embodied agent character, in line with its development line. Depending of the campaign, the role of the virtual character is to persuade the user to act on a certain way to learn a particular aspect, to visit a space he could ignore etc.

WP 8 applied scenario

Starting from Cantoche experience and views, we have outlined the following overall scenario for WP 8.

The overall scenario for WP 8 is the launch of a promotion campaign based on intelligent interfaces. The envisaged idea is to consider a variety of means for inducing some behaviour in the audience, by resorting to emotion processing. Some means are for immediate action inducement, some for delayed effect (such as slogans that help remember a concept). Different means can be: a) targeted to single persons, b) targeted to groups c) aimed at producing broadcast messages, or d) can be tools that help conceptually a human advertiser produce a high quality message. Means are mostly monological, but some level of interactivity, from basic feedback to some limited form of dialogue can be included. At this

moment, several ideas can be part of this scenario such as promotion campaign for cultural heritage artifacts, within a museum or before getting to a museum, for using better a household appliance, for giving advice on the way to drive, for discovering cultural aspects of a city or similar. The specific scenario will be defined in the next few months.

Evaluation

New methodologies are needed to evaluate emotions in persuasive communication. This work will be done in collaboration with WP 9. As a concrete research program example, we will go through some aspects of the evaluation of persuasive and humorous systems.

As indicated above, a thorough understanding of the role of the expression of emotions in persuasion is missing. Here we suggest a theoretical framework that can help such understanding and an empirical exploration of this framework. In considering what is the role of emotions expressed by the source of a message in the persuasion of a receiver we assume that such emotions affect the extent to which the receiver finds the message reliable. Thus, in our view, the function of emotional expressions of a source in persuasion is to serve as credibility enhancers (i.e., increase the perceived trustworthiness of the message). This assumption is based on the fact that emotions are commonly regarded as serving a communicative function, both intra-and inter-individually [e.g., Clore, 94; Oatley, 92]. In accord with [Zahavi, 75, 77a, 77b, 97], it is further assumed that emotions are perceived as relatively reliable indications of one's inner state including attitudes and positions. Hence, in the context of persuasion, communications that include emotional expressions are more persuasive to the extent that the emotion that accompanies that communication is in fit with the content of the message. For example, a message of a complaint is expected to be seen as more reliable if it is voiced angrily than if it is wrapped by an expression of indifference or a positive emotion. Research conducted in the context of complaints indeed indicates that this is the case [Hareli & Harush, 04]. The assumed connection between reliability and persuasion is in line with research indicating that source credibility is a factor that enhances persuasion [Howard, James, & Kerley, 53]. We plan to study these assumptions by having participants attend to different recorded communications in which the fit between the content of the message and the accompanying emotion expressed by the source is manipulated. These participants will have then to rate persuasion level and intended behavior. At a later stage, we plan to replicate this study while using artificial persuasion agents designed to convey different messages while emitting different emotional expressions. Participants will have to evaluate these messages, including the extent to which they are persuasive. In this context we suggest the use of Embodied Conversational Agents (ECA). These ECA's could be set to act according to the emotion-message fitness hypothesis described above. This will enable to test and implement the framework suggested above in the design of effective persuasion agents.

As mentioned above, another significant aspect of the involvement of emotions in persuasion is the use of induction of emotions in perceivers as means for enhanced persuasion. To that aim, we plan to focus on humour as an example of an emotion induction system and evaluate the potential use of computational humour systems to induce emotions in perceivers of persuasive messages. In the first stage we plan an empirical test of the role that humour plays in persuasion. To date, an understanding of the role of humour in persuasion is missing. In exploring this issue, we plan an empirical study in which we will test the effect of humorous content incorporated in persuasive messages on persuasion. Here too the ELM serves as a conceptual framework.

At later stages we plan to implement the understanding stemming from this research in the design of persuasion systems that will use humour as means of inducing emotions in receivers of persuasion messages. In the context of the induction of humour as means for the enhancement of persuasion, we plan to use the computational humour system designed by Stock & Strapparava (02).

Thus, the design of a persuasion agent would be guided by the theoretical framework presented above and evaluated experimentally. In the process of evaluation we plan to assess the following issues:

- a. The persuasion agents should accomplish their function, i.e., be persuasive and do so via the means that were planned.
- b. The purpose of the application should comply with ethical considerations
- c. Applications should be functional, i.e., achieve a change of mind in the persuadee', preferably while considering some cultural variations.

Accordingly, these aspects need to be considered prior to the design of a given application and evaluated when the application is complete.

Within the context of HUMAINE, evaluation must be a synchronized joint effort that will join together groups that plan applications and groups that can plan evaluation studies. The University of Haifa is proposing to be responsible for the planning of evaluation experiments tailored at assessing the points raised above.

4 Proposed allocation of tasks

4.1 Plan up to M 30

Task 8.1 Definition of themes, methodology, components and evaluation

Task 8.2 Development of models and initial prototypes.

Task 8.3 Workshop organisation

Task 8.4 Pilot evaluation and planning of components and extended prototypes

Task 8.5 Theory refinement, discussion of new issues, dissemination

4.2 Final period

Task 8.6 New version of components and prototypes

Task 8.7 Evaluation and book

5 Provisional timeline

5.1 Up to Month 30

Key actions	Estimated time span and completion	Type of associated deliverable	Estimated date of delivery
Task 8.1 Definition of themes, methodology, components and evaluation	M13-M18	Report	M18
Task 8.2 Development of models and initial prototypes	M19-M23	Software	M23
Task 8.3 Workshop organisation	M20-M23	Workshop Proceedings	M23
Task 8.4 Pilot evaluation and planning of extended components and prototypes	M24-M30	Evaluation report	M30
Task 8.5 Theory refinement, discussion of new issues, dissemination	M13-M30	Report with book skeleton	M30

5.2 Final period

Key actions	Estimated completion	Type of associated deliverable	Estimated date of delivery
Task 8.6 New version of components and prototypes	M30 -M 42	1 Software 2 report	M42
Task 8.7 Evaluation and book completion	M42-M48	1 Evaluation report 2 book to publisher	M48