Approaches to Verbal Persuasion in Intelligent User Interfaces

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1 Introduction

People tend to treat computers as social actors, even if these are usually designed as mere tools. This forces computers to play a social role without having the social skills to be successful (Reeves and Nass, 1996).

Persuasion is likely to become a hot topic for intelligent interfaces (Stock et al., 2006). As opposed to traditional scenarios of intelligent user interfaces (hereafter IUI), future intelligent systems may have contextual goals to pursue that aims at inducing the user, or in general, the audience, to perform a specific action in the real world.

These systems will have to take into account the social environment, exploit the situational context, and enhance emotional aspects in communication. Scenarios that can be envisaged include dynamic advertisement, preventive medicine, social action, and edutainment. In all these scenarios what really matters is not just the content, but the overall impact of the communication.

In this chapter, we will consider natural language generation (NLG) of persuasive messages (either written or spoken), as the central aspect of communication. NLG is the branch of natural language processing that deals with the automatic production of texts (Reiter and Dale, 2000).

The aim is to provide an overview of theories and systems that have the capability of reasoning about the effectiveness of the message, as well as about the high-level goals and content. We will also consider those aspects of multimodal realization that are strictly connected to NLG (e.g. markup languages, see the final chapter in Part IV).

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This chapter is structured as follow: Sect. 2 introduces the basis about persuasive communication (theories, main dimensions included in the phenomena, and related concepts). Sect. 3 describes the connection between NLG and persuasion, along with the main areas of research and challenges. Finally, Sect. 4 presents a review of persuasive systems.

2 Persuasive Communication and Related Concepts

According to Perelman and Olbrechts-Tyteca (1969) persuasion is a skill that human beings use – in communication – in order to make their partners perform certain actions or collaborate in various activities (a similar definition has been proposed by Moulin et al., 2002). Historically, in the human sciences various definitions similar to Perelman and Olbrechts-Tyteca's have been proposed. Most of them have a common core, addressing

methodologies aiming at changing, by means of communication, the mental state of the receiver.

We refer to the chapter by M. Miceli et al., this volume for a thorough analysis. In these definitions there are three elements at play that are strictly interleaved: the persuader, the persuadee, and the message. All these elements are necessary in explaining how the persuasive process occurs, although some definitions may focus on one element more than on the others, as below:

- Those focusing mainly on message structure – for example, how an argument can be structured to be effective (Toulmin, 1958; Perelman and Olbrechts-Tyteca, 1969; Walton, 1996).
- Those that address the persuader side and the cognitive processes that take place in their mind for generating effective arguments – e.g., the selection of the "heuristics" through which the receiver may be persuaded (e.g., Chaiken, 1980, or Cialdini, 1993).
- Those that focus on the persuadee side trying to understand on which cognitive processes persuasive messages hinge on. Petty and Cacioppo (1986), for example, focus on the inferential routes that the receiver uses to process the message (central or peripheral, i.e., rational or "affective").
- Others that broadly refer to the beliefs and goals of both persuader and persuadee and how they are related (Poggi, 2005).

2.1 Dimensions of Verbal Persuasion

There are several dimensions of persuasion along which broad areas of study can be classified. To build persuasive systems it is necessary to individuate systematically these dimensions of persuasion at play and the kind of interaction we want to address:

1. Action vs. behavior and attitude inducement:

   a. Behavior inducement – Changing, in a stable and persistent manner, the way an agent acts, for example, in response to certain events or state of affairs in the world. This is meant to be a long-term effect.
   b. Attitude inducement – Changing, in a stable and persistent manner, the way an agent evaluates events, state of affairs, or objects. This effect is also long term.
   c. Action inducement – Changing a particular planned action of an agent. This effect is short term.

2. Argumentation specific vs. fully persuasive:

   There are situations in which a simple argumentative approach may suffice in creating effective messages (e.g., when persuadee "resistance" to changing is low or the performing of the required action is more a matter of knowledge rather than a matter of will). In other situations mixed approaches are needed.

3. Audience specific vs. universal

   a. One of the definitions of persuasion given by Perelman and Olbrechts-Tyteca (1969) claims that what characterizes persuasion is it being audience specific, namely its capacity of adapting the topic to the specific listeners.
   b. On the other hand, Cialdini (1993) takes the opposite position: all the strategies he analyzes are meant to be universal (since they use cognitive patterns of the receiver which are common to everybody).

4. Monological vs. dialogical

   a. Perelman's analysis of persuasion, since concerned with rhetoric (how to create effective discourses), is more involved with monological interaction.
   b. Cialdini's analysis of persuasion, since concerned mainly with selling scenarios, is focused on dialogical interactions (e.g., *foot in the door* strategy, *door in the face* strategy).

5. Domain specific vs. universal

   a. Some strategies are typically domain specific (like *fake discount* strategy to sell more)
   b. Other strategies are universal, that is, applicable to every situation (like *fear appeals* strategy with impressionable persons)

6. Sole language vs. multimodality

   This distinction is relevant especially with the coming of the new media and for IUI, it is a crucial field of research.

2.2 Elements Addressed by Persuasion

Persuasion mechanisms include the following four aspects:

1. The cognitive state of the participants – The beliefs and goals of both persuader and persuadee.
2. Their social relations – Social power, shared goals, and so on.
3. Their emotional state – Both persuader's and persuadee's.
4. The context in which the interaction takes place.

A brief description of these aspects follows:

Beliefs and goals of both the participants about the domain of the interaction are prerequisite for persuasive interaction, because persuasion is a communication leading to belief adoption, with the overall goal of inducing an action by the user by modifying their preexistent goals (see the Chapter by M. Micel; et al., this volume).

Social relations exist between persuadee and persuader (that can play the role of a museum guide, a car seller, etc.) and between persuadee and other relevant persons such as experts and parents.

Emotional elements can enhance or lower message effectiveness. Gmytrasiewicz and Lisetti (2001) propose a useful framework on how the emotions *felt* by an agent can change their own behavior. Still, for persuasive purposes, the focus should be posed on how emotional elements (either on persuader or persuadee side) can be *used* to increase or diminish the persuasiveness of a message. There are four dimensions to be considered:

1. The current emotional state of the persuadee – How it affects the strategy selection of the persuader.
2. The emotional state expressed by the persuader – What emotion the persuader must display to maximize the persuasive force of the message.
3. The emotional state possibly produced in the persuadee by the message – The induced emotional state may not be desirable, and it may be necessary to take it into consideration for subsequent interactions.
4. The current emotional state of the persuader – How it affects their strategy selection.

It is still a matter of debate whether the current emotional state of the persuader should actually be taken into consideration in persuasive interfaces. The two main standpoints are as follows:

1. A perfect persuasive agent should be emotion neutral; they just have to display the most effective emotion for the current persuasive goal.
2. For a persuader, to feel emotions is a good way to handle unpredicted situations and a resource for responding to the persuadee's moves.

2.3 Related Concepts

Social influence Affecting or changing how someone behaves or thinks (by changing their mental state). Social influence is a superset of persuasion since the aforementioned core definition of persuasion (see the previous section) restricts the field of coverage by making reference to both the concepts of "aim" and "communication." The term "aim" indicates that persuasion is an intentional process: there is persuasion only when there is the intention to produce a change in the mental state of the receiver (this is not the case, for example, of unintended induction of emulation phenomena). The term "communication" rules out those effects of (social) influence that, for example, are caused by mere exposition to repeated stimuli.

Negotiation = Broadly speaking, negotiation is an interactive process between two or more parties trying to influence each other to achieve goals which they cannot (or prefer not to) achieve on their own; these goals may conflict or depend upon one another. Negotiation is thus a form of alternative dispute resolution. Even though persuasion can be a resource for negotiation, in negotiation participation is voluntary (whereas in persuasion, it can be unwilled), and the structure is intrinsically dialogical (whereas in persuasion, it can also be monological).

Argumentation = 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 latter uses "arational elements" like emotions. In our view, however, argumentation is a resource for persuasion because

1. Planning of persuasive messages involves a "rational" activity, even when emotion inducement is employed as a means to increase the persuasion strength of a message. On the other hand, the way persuasion is performed (items selected, their order of presentation, their "surface" formulation) also depends on the emotional state of the persuader.
2. Argumentation is concerned with the goal of making the receiver believe a certain proposition (influence their mental state) and, apart from coercion, the only way to make someone do something (persuasion) is to change their beliefs (Castelfranchi, 1996).

Since persuasion includes "arational" elements as well, it is a "superset" of argumentation, but this does not rule out the fact that there is a role for emotion within argumentation (Miceli et al., 2006): through arousal of emotions (see Rhetoric) or through appeal to expected emotions. In classical argumentation, though, these problems are not addressed since emotional argumentation is often considered as some sort of "deceptive" argumentation (Grasso et al., 2000).

In our view a better distinction between argumentation and persuasion can be drawn considering their different foci of attention: while the former is focused on the *correctness* of the message (it being a *valid* argument) the latter is more concerned with its *effectiveness*. The point is that an argument can be valid but not effective

or, on the contrary, can be effective but not valid (as an example see the discussion about the goat problem explanation by Horacek, 2006).

Natural argumentation = The recent area of natural argumentation tries to bridge argumentation and persuasion by focusing, for example, on the problem of the adequacy – effectiveness – of the message (Fiedler and Horacek, 2002). Even in professional settings, such as juridical argumentation, extra-rational elements can play a major role (Lodder, 1999). Recent works have studied applications of natural argumentation (Walton and Reed, 2002; Das, 2002); argumentation-based text generation has been proposed by Zukerman and colleagues (2000), relying on a Bayesian approach. Negotiation has also been widely investigated and modeled in a computational framework; see, for instance, Kraus et al. (1998) and Parson and Jennings (1996). A thorough survey on the area can be found in the work by Reed and Grasso (2007).

Coercion = using force to "persuade" someone to do something they are not willing to do. Obviously coercion falls out of the definition of persuasion.

Rhetoric = the study of how language can be used effectively. This area of studies concerns the linguistic means of persuasion (one of the main means, but not the only one).

Irony = It refers to the practice of saying one thing while meaning another. Irony occurs when a word or phrase has a surface meaning, but another contradictory meaning beneath the surface. Irony is a widely used rhetorical artifice, especially in advertisement. For a more detailed description, please see the last chapter in this Part.

3 Natural Language Generation for Persuasion

3.1 What Is NLG

At the root of the theme of intelligent information presentation we can consider several scientific areas, but at least NLG is fundamental. NLG is the branch of natural language processing that deals with the automatic production of texts in human languages, often starting from non-linguistic input (Reiter and Dale, 2000). Normally the field is described as the investigation of communicative goals, the dynamic choice of what to say, the planning of the overall rhetorical structure of the text, and the actual realization of sentences on the basis of grammar and lexicon. The three-stages model proposed in Reiter and Dale (2000) is usually taken as a reference:

1. *Document planning* that decides the content and the structure of the message to be generated (sometimes called *strategic planning*).
2. *Microplanning* that decides how information structure should be expressed linguistically, involving mainly lexical choice.

3. *Surface realization* that generates the final output according to the decisions of the previous stages and according to, for example, grammatical and anaphoric constraints (sometimes called *tactical planning*).

NLG approaches can be roughly divided into two areas (Reiter et al., 2003b):

1. Knowledge-based approaches (for an overview see Scott et al., 1991)
2. Statistically based approaches (for an overview see Jurafsky and Martin, 2000).

While at the beginning of NLG the main approaches have been knowledge based, in recent years, statistical approaches are becoming widely used (especially not only for tactical planning – e.g., by using N-grams (Langkilde and Knight, 1998) – but also for strategic planning (Duboue and McKeown, 2003)). Other approaches such as the one proposed by Radev and McKeown (1997) rely on automatic acquisition of sentences mapped on their functional description, to overcome the problem of simple canned texts extraction. More recently, Guerini et al. (2008a) investigated an approach for persuasive natural language processing based on the analysis of a specific corpus of political speeches tagged with audience reactions.

3.2 NLG and Monological Persuasion

Most systems and approaches in NLG are based on descriptive tasks, focusing on texts which realize a single, often informative, communicative goal, as opposed to persuasive NLG where the communicative goal is usually surmounted by reasoning about the persuadee's behavior modification.

Persuasive features can have an impact on both strategic and tactical levels since the effectiveness of a message can be enhanced by appropriate content selection, text planning, and linguistic choices.

1. In strategic planning, for example, a widely used reference theory is the one proposed by Mann and Thompson. This theory, called Rhetorical Structure Theory (RST) (Mann and Thompson, 1987) – formalized by Marcu (1997) – puts forward the idea that the structure of many texts is a tree built recursively starting from atomic constituents (e.g., clauses) connected through particular relations. These relations, called rhetorical relations (RRs), account for the structure and content ordering of the text. In almost every relation a text span plays a major role: this is often referred to as "nucleus" (as opposed to "satellite" that plays an ancillary role). There have been various attempts and debates about the possible use of RRs in persuasive message generation, e.g., Marcu (1996), Reed and Long (1998), Kibble (2006), and Guerini et al. (2004).
2. In tactical planning, for example, the lexical choice of what to say can be – persuasively – driven by reasoning on the different emotional impact that words can have in conveying a given meaning: techniques which allow the speaker to

slant a text (e.g., selecting "kick the bucket" instead of "die") or stress particular concepts (e.g., by means of repetition) are needed. For a general discussion about this point see chapter 4 of Hovy (1988); for a specific survey on affective lexicalization components see de Rosis and Grasso (2000) or Piwek (2002). An interesting approach has been proposed by Fleiscman and Hovy (2002).

Multimodal generation addresses similar problems as NLG, but goes "a step further" since the message is communicated across more than one modality, and persuasive features in this case can have a deep impact.

3.3 NLG and Dialogical Persuasion

Instead of being seen as a predefined, integrated set of propositions, in a dialogical perspective argumentation is seen as a sequence of moves in which two parties (persuader and persuadee) are reasoning together on some subjects. The dialogue may be more or less symmetrical, as far as the initiative in persuasion and argumentation is concerned: the role of persuader and persuadee may be fixed, or alternate, during interaction.

Dialogic persuasion is not restricted to situations in which two parties are trying to resolve a conflict of opinion or attempt to influence each other's behavior. Some argumentative exchanges may occur in almost any kind of context: one of the most recent examples is the case of Online Dispute Resolution, in which an arbitration environment supports communication and discussion in web-based groups (Vreeswijk and Lodder, 2005; Walton and Godden, 2005). In Walton's New Dialectic (Walton, 1998), six basic types of dialogues are proposed:

- Persuasion: the goal is to resolve a conflict of opinion;
- Inquiry: the goal is to find or verify evidence and proving or disproving a hypothesis.
- Negotiation: the starting point is a conflict of interests; the goal is to find a compromise between what each participant wants;
- Information seeking: the goal is to acquire or give information;
- Deliberation: the goal is to decide the best available course of action;
- Eristic: the goal is to reveal the basis of a conflict.

In some of these dialogues, persuasion and argumentation are central, while in others they may enter only in some phases. On the other hand, during an argumentation sequence, there can be "dialectical shifts" of context from one type of dialogue to another. This makes the modeling task particularly difficult.

While monological persuasion is characterized by the three stages of planning (see Sect. 3.1) in "pure" persuasion dialogues, the sequence of exchanges includes some typical phases, and forms of reasoning, by the persuader:

- Make a proposal: after reasoning on the persuadee's mind, propose an action or a claim by giving reasons as grounds for supporting the proposal;
- Observe the persuadee's reaction: what does they say or express differently;
- Classify it (a request of justification, an objection, with or without counter-argumentation, a refusal, etc.);
- Reason (again) on the persuadee's mind to interpret the persuadee's reaction by placing it into her presumed set of attitudes: this requires a belief–desire–intention model of mind and reasoning (Wooldridge, 2002), eventually enhanced with emotions in a BDI&E model (Carofiglio and de Rosis, 2005);
- Justify it or defend the own proposal if possible; retract it if needed, find an alternative, and relate new argumentation to the previous one.

A proposal may be criticized by the persuadee in several ways (e.g., by questioning the goal premises, by attacking them with counter-arguments, by undercutting the inferential link between premises and conclusion (Walton, 2006a)), and the persuader must be able to respond appropriately to all the situations.

The complexity of Walton's distinction between "reasoning and argumentation" (Walton, 1990) – that is, between a phase of reasoning on the persuadee's mind to select an appropriate strategy and a phase of translation into a coherent message – increases when argumentation becomes dialogic. At every dialogue step, the persuader must decide on which part of their reasoning to make explicit in generating the argument and which one to hide or to postpone. In addition, a refined ability to "interpret and reason on the persuadee's reaction" must be added to the system.

This new reasoning ability becomes quite complex when context, personality, and emotional factors are considered: research about consumers' behaviors and attitudes contributed considerably in increasing knowledge in this domain. For example, not only the message features but also the persuadee's perceived features, like "credibility," "likability," "attractiveness," (O'Keefe, 2002), must be considered, as well as the persuadee's evaluation of the effectiveness and appropriateness of the persuasion tactics (Friestad and Wright, 1994).

On the other hand, receivers may be vulnerable to blatant persuasion attempts (Bosmans and Warlop, 2005). They may also be biased toward a persuasive attempt, being skeptical, defensive, or hostile, either in general or toward a particular persuader (Ahluwalia, 2000). This kind of "resistance" can include different mixtures of rational and emotional components (Coutinho and Sagarin, 2006).

More in general, evaluation of persuasion attempts by persuadees may be influenced by affective factors. Some of these factors are stable (like personality traits), others are more or less transient. For instance, positive mood seems to reduce systematic processing of information, whereas negative mood enhances it (Hullett, 2005); positive feelings lead to more positive evaluation of information received, while the opposite seems to hold for negative feelings (Petty et al., 1991). If a persuasion move aims at influencing the persuadee's attitude, it has been demonstrated that the persuader's attitudes are influenced, in turn, by the success or failure of their persuasion attempts: this is known as a referral-backfire effect (Geyskens et al., 2006).

Although theoretical aspects of dialogic persuasion have been extensively investigated in the philosophical and the marketing studies domains, examples of dialogical persuasion prototype systems are few and quite recent.

3.4 Other Aspects of Verbal Persuasion: Storytelling

A recent topic of research in verbal persuasion deals with narration and storytelling.

Story represents a fundamental structuring of human experience, both individual and collective (Young, 2001). According to the constructivist theory, people are not passive recipients of their experience but active constructors of their own reality through mental activity (Piaget, 1972). Hence, story can be viewed as a process of sense making via narrative organization, the process which Aylett (2000) termed as the storification process. It is a specific mechanism through which the real world can be created in the imagination of the receivers.

Story has been widely used in subjects where temporal complexity and social interaction are significant issues. These include language development, literature study, history, and social science. Personal, social, and health education, in which the pedagogical aims involve attitudes and behaviors and not just knowledge, has also applied role-play widely. Social interaction has been used in educational role-play as the stimulus for challenging and changing existing beliefs (Piaget, 1972) and can result in significant behavioral changes (Lewin, 1951). Surprisingly, there is not much research on persuasion up to date that attempts to use story as a source of persuasive message, considering its high significance for social and emotional learning (Davison and Arthur, 2003; Henriksen 2004).

The nature of story as persuasive message can vary depending on the information that the persuader has about the persuadee. If the persuader has a complete model of the persuadee's current emotional and cognitive states, a full story can be generated using natural language approaches discussed in the previous sections. If this information is not available, improvisational storytelling techniques (Ibanez, 2004; Lim, 2007) may be adopted, whereby the persuader shapes the story dynamically based on the persuadee's feedback as in dialogical situations.

Since a story molds and reflects human experiences, emotions and personality are important elements that contribute to its structure and content. According to Nass et al. (1995), in human–computer interaction, people prefer computer agents that align to them and they tend to rate these agents as more helpful and more intelligent. This implies that by assigning the story with a personality that conforms to the persuadee's personality, an improved persuasive effect may be achieved.

A particular viewpoint can also be slipped into the persuadee more easily if the persuader can induce the persuadee's mental attitude and mold a message or story to suit the persuadee's feeling. This is due to the fact that people tend to believe rumors or arguments that are consonant to their emotional attitude (Frijda et al., 2000), that is, we pay attention to what interests us. Emotions can also generate functional beliefs that help to achieve emotional goals such as increasing one's sense of competence, making one feel better, or getting rid of dissonance as demonstrated

by Harmon-Jones (2000). So, a persuader can persuade the persuadee to look at a particular subject or event from its own point of view and experiences, challenging or changing their existing beliefs, and structuring their mental picture of the natural world by invoking empathy through stories. For more arguments on how emotions can lead to belief changes in society, please refer to Lim (2007).

From the above discussion, the use of story as persuasive message seems to be a promising direction for further study.

3.5 Meta-analytic Research for Persuasive NLG

There already exists a substantial body of social-scientific theory and research concerning persuasive communication. This work offers the possibility of informing the development of NLG persuasion systems, by providing empirical evidence concerning (for example) how specific message variations affect persuasive outcomes. However, the task of obtaining dependable generalizations about factors influencing persuasive effectiveness has been hampered in two ways. First, on many research questions, relatively little research evidence is in hand. No single study of a particular message variation can provide good evidence for broad generalizations about the effects of that factor. It would obviously be unwise to design NLG persuasion systems based on poorly evidenced conclusions. Second, even when a substantial number of studies have been conducted on a given question, relatively little attention has been devoted to research organization and synthesis in this area. However, in recent years, a number of meta-analytic reviews of persuasion effects research have appeared, including reviews of the persuasiveness of one-sided and two-sided messages (O'Keefe, 1999a), fear appeals (Witte and Allen, 2000), guilt appeals (O'Keefe, 2000), the use of metaphor (Sopory and Dillard, 2002), conclusion explicitness (O'Keefe, 1997), and gain-framed and loss-framed appeals (O'Keefe and Jensen, 2006).

Considered broadly, these meta-analytic reviews point to two general conclusions about how message variations can influence persuasive success (O'Keefe, 1999b). First, the average effect size (the magnitude of difference that it makes to persuasiveness to use one kind of appeal as opposed to another) is usually relatively small; expressed as a correlation, average effect sizes rarely exceed 0.20 and commonly are in the neighborhood of 0.10. Second, for any given factor, effect sizes are usually quite variable from one study to another. This finding obviously underscores the dangers of relying on any single study's results (in trying to identify dependable generalizations), but it also emphasizes that the implementation (in an NLG persuasion system) of any specific message design principle is likely to itself produce variable effects from one instance (one application) to another. Taken together, these two conclusions imply that there is no "magic bullet" for persuasion – no message variation that consistently (in every instance) produces large increases in persuasiveness. Even so, NLG persuasion systems should be designed in ways that make use of the accumulated knowledge about how to maximize the likelihood of success of persuasive messages.

3.6 Challenges

In this section a list of the main challenges that are to be taken into consideration for building effective persuasive IUI is presented.

1. *Porting of strategies*. There is a rich repertoire of persuasive strategies coming from human sciences (in addition to those already mentioned) that can be used for persuasive and multimodal NLG. Most of them address specific aspects of persuasion, for example, guilty feeling induction (Miceli, 1992), use of promises and threats (Castelfranchi and Guerini, 2007), ordering of positive or negative arguments to create proper frames in persuadee (Prospect Theory (Kahneman et al., 1982)). This collection is not structured: social, emotional, and cognitive aspects interact with each other. There is the need for a porting and structuring of such concepts. The *media equation* supports this view (Reeves and Nass, 1996).
2. *Knowledge representation*. To simulate natural argumentation and (emotional) persuasion, it is necessary 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). Starting from the continuum which characterizes the various (emotional and non-emotional) persuasion modes, a framework which tries to unify the various items of this continuum must be given (see, for example, Guerini et al. 2003). Investigating the various (emotional and non-emotional) persuasion and argumentation strategies (like those in Prakken et al. 2003 Toulmin 1958) and proposing a method to formalize them, by representing the various sources of uncertainty and incomplete knowledge they may include, is just the first step. Related aspects, fundamental for dialogue interactions, like critical questions, counter-arguments, must be taken into consideration.
3. *Measures needed in persuasion.* 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, it is necessary to furnish models of measurement of the strength of persuasive strategies and of other related concepts such as argumentation strength (Sillince and Minors, 1991), probative weight (Walton, 2000), dialectical relevance (Walton, 1999), and impact (Zukerman et al., 1999; Zuckerman, 2001). Various methods have been proposed for representing uncertainty in this domain: see for instance, BIAS (Zukerman et al., 1999; Zuckerman, 2001) and Carofiglio (2004). Starting from these concepts more complex measures can be created, like emotional impact of a message that has been explored in Carofiglio and de Rosis (2003).
4. *User modeling.* To produce *effective* communication, tailored messages are needed (regardless of the universal-or audience-specific nature of the used persuasive strategies). Detailed *user models* are then necessary for tailoring the message. These models can have different degrees of complexity depending on

the kind of interaction modeled (static user model for monological interaction may suffice, dynamic user models are instead necessary for dialogical situations).
5. Integrated models of emotion manipulation and beliefs and goal induction are necessary; they can use BDI&E (belief, desire, intention, and emotions) approaches to model how intentions and commitments are produced (and induced). These models can be used not only to describe the characteristics of persuadee (and how these characteristics are affected by a persuasive message) so to select the "best" persuasive move the system can make, in a given situation; they can also be used to describe the process of persuasion itself (i.e., the planning of a persuasive message).
6. *Multimodality*. The realization of a persuasion message requires the expression in a communication language. In most approaches natural language is the main modality, but it can be combined with music, kinetic typography, ECAs, and so on. For instance, a talking head may express the mood of the message originator, a music theme may emphasize a given emotional aspect, or simply, a relevant image can be combined with the produced text. Multimodality poses lots of challenges: for example, the question whether an ECA should be credible or realistic (it can be argued that, with children, cartoon-style ECAs are more credible – and persuasively effective – than realistic ones).
7. *Evaluation*. Persuasive systems need to be evaluated. That is, it is not sufficient that they are theoretically sound: they also have to be proven effective with real users. Evaluation is not straightforward at all: it is necessary to point out carefully all the variables that can affect the effectiveness of the system and how they can correlate (context of use, scenario of the interaction, typology of the user, required task, persuasive strategies at hand, and so on). Specific evaluation methodologies have to be defined.
8. *Indirect aspects*. "Indirect aspects" like attention and memorization can affect the effectiveness of persuasive messages. For example, 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 "colored" terms. Similar considerations can be made about memorization.
9. *Ethical reasoning*. Finally, ethical issues must be addressed. As artificial agents are becoming more complex and common in our everyday life, the need for an ethical design of such agents is becoming more compelling, especially if, as in the present case, the focus is on persuasiveness. A set of principled guidelines for design and implementation of ethical persuasive agents is necessary (the seminal work of Berdichevsky and Neuenschwander (1999) goes in this direction). Future challenges will address meta-planning models of ethical reasoning, see, for example, Guerini and Stock (2005).

These challenges are strictly interconnected; modeling decisions of one aspect often have consequences on other aspects.

4 Persuasive Systems

In the following section we provide an overview of various theories and systems addressing verbal persuasion issues for IUI. These systems have been classified according to the most salient characteristics they address (monological, argumentative and dialogical, emotional, multimodal aspects). The fact that a system appears in one group does not rule out the fact that it can also address aspects of the other groups.

4.1 Monological Persuasion Systems

The area of health communication is one of the first where the potentials of persuasive features for NLG were investigated. In particular, the focus was posed on tailoring messages (for a detailed overview on NLG tailoring systems for health communication, see Kukafka, 2005). Here we will mention just a couple of these systems, then we will focus on general purpose (not domain-specific) systems.

- STOP is one of the best known systems for behavior inducement that exploited persuasion (Reiter et al., 2003a). STOP is (mainly) an NLG system aiming at inducing users to stop smoking. It produces a tailored smoking-cessation letter, based on the user's response in a questionnaire. The NLG process follows the classical three-stage pipeline as described in Reiter and Dale (2000). The tailoring process is done by dividing smokers into categories and then applying category-specific schema to generate the letter. The main limitation is that this approach is strongly domain specific and all the reasoning is based on expert-oriented knowledge acquisition for the clinical smoking domain (Reiter et al., 2003b). This renders the system unportable.
- *Migraine* (Carenini et al., 1994) is a natural language generation system for producing information sheets for migraine patients. It consists of three main components: (a) an interactive history-taking module that collects information from patients; (b) an intelligent explanation module that generates explanations tailored to individual patient and responds to follow-up questions; and (c) an interaction manager that presents the interactive information sheet on the screen and manages the subsequent interaction with the patient. *Migraine* is different from STOP in that it adds interactivity to the interaction with the patients, furnishing some limited form of "dialogical" interaction (in a question answer fashion, by clicking on portions of the text and by selecting available questions from menus).
- *Promoter* (Guerini et al., 2007; Guerini, 2006) is a prototype that uses strategies gathered from different persuasive theories and subsumed in a general planning framework for multimodal message generation. The planning framework consists of a taxonomy of strategies (rules that have some applicability conditions based on the social, emotional, and cognitive context of interaction) and a meta-reasoning module (used for content selection, ordering, and modification

to create complex messages). *Promoter*, by means of selection theorems, also accounts for the interaction between persuasion and rhetorical relations selection.

- Another persuasive NLG system is the one presented by Reed and colleagues (Reed et al., 1996, 1997; Reed and Long, 1997) that uses two modules, argument structure (AS) and eloquence generation (EG), connected to the LOLITA system (Smith et al., 1994) for natural language realization. In this approach the system starts with a generic goal of making the user believe a certain proposition. The AS module produces a logical form of the argument, employing various logical and fallacy operators. Then the EG level modifies this structure by using heuristics to render the message more persuasive. The main limitation is that the system generates an "argumentative" text and then modifies it to make it (more) persuasive. But persuasion is a phenomenon that drives text planning, not simply a "modifier" of the process.
- DIPLOMAT (Kraus and Lehmann, 1995) is a negotiating automated agent built for playing the *Diplomacy* game with human users. The ability to negotiate requires different persuasive skills. In particular this agent is able to perform persuasive actions like threatening, promising, giving explanations and in general it is designed to convince other players. The architecture of DIPLOMAT is developed on a multi-agent platform. Tested with human players, DIPLOMAT outperformed them, and this is a notable result given the complexity and uncertainty of the selected scenario. Despite the success of the system, its usefulness for the present survey is limited because (1) it was developed for a task – negotiation – which is related, but not coincident, to persuasion; (2) the architecture is domain dependent; (3) it uses a negotiation language that is an English-like logical language, no real NLG process is done. Players must previously learn this language to interact with the system.
- Lim et al. (2005) present an attempt to bind persuasion and storytelling. The architecture of an empathic tour guide system (a context-aware mobile system that includes an "intelligent empathic guide with attitude") is described. It consists of two virtual agents each possessing a contrasting personality, presenting users with different versions of the story of the same event or place. An emergent empathic model with personality is proposed as a mechanism for action selection and affective processing. The guide creates personalized communication applying improvisational storytelling techniques to persuade the user to think in the way it thinks; by invoking empathy, the guide makes the user see an event in a deeper sense.

4.2 Argumentative and Dialogical Persuasion systems

The theory of argumentation dialogues originates from research about expert systems, in which an advice-giving system was built to suggest appropriate therapies in a given situation (Buchanan and Shortliffe, 1984). A key function was to support their suggestion with explanations and clarifications after requests from the

user, including critiques to the suggested plan: they therefore set the framework for subsequent developments of criticizing argumentation attempts (Walton, 2006b). In the multi-agent system domain, this kind of dialogues was subsequently employed, by agents, to distribute and contract roles and tasks (negotiation); several proposals about the language to employ and how an artificial agent's mind could be simulated were made (Wooldridge, 2002; Rao and Georgeff, 1991). This representation was seen as the object of "second-order reasoning" applied in planning a dialogue move and interpreting the agent's reaction. Other computational models of dialogical persuasion (e.g., Grasso et al., 2000; Walton and Reed, 2002; Zukerman et al., 1999) were built on the seminal work developed by linguists, philosophers, and cognitive psychologists (e.g., Toulmin (1958)).

- NAG (nice argument generator) is a precursor of argumentation systems (Zukerman et al., 2000). It is concerned with the abstract form of the unfolding of the argument (e.g., *reductio ad absurdum*, *inference to the best explanation*, *reasoning by cases*), and the structure of persuasive messages is limited to one inference schema per move. The system is based on Bayesian networks (BNs): arguments are represented as networks of nodes (representing propositions) and links (representing inferences). BNs have been chosen in order to represent normatively correct reasoning under uncertainty. The system also includes a module, aimed at interpreting the persuadees' reaction according to the system's knowledge of their presumed set of beliefs, and a generation component (Zukerman and George, 2005). Although the two components have not yet been integrated into a dialogic argumentation prototype system, they set some of the principles that guide their development.
- By seeing monologues as "inner dialogues" Kibble (2006) studied the kinds of communicative acts that are employed in persuasion dialogues (in particular, in challenges and clarification requests) and how they may be represented in rhetorical structures.
- In ASD (argumentation scheme dialogue), Reed and Walton (2007) use the language of formal dialectics to define a dialectical system in terms of locution rules (statements, withdrawals, questions, challenges, and critical attacks), commitment rules (effects of locution rules on the two interlocutor's knowledge), and dialogue rules (sequencing of communicative acts).
- *Magtalo* (Multi-agent argumentation, logic, and opinion) is a prototype environment for debate. It supports flexible intuitive interaction with data in complex debate domains to facilitate understanding, assimilation, and structured knowledge elicitation, which enable the expansion of domain resources (Reed and Wells, 2007).
- The PORTIA (Mazzotta et al., 2007) prototype is based on Miceli et al.'s theory of emotional persuasion (Miceli et al., 2006). It implements Walton's idea of separation between a "reasoning" and an "argumentation" phase (Walton, 1990) by representing with Bayesian networks the uncertainty inherent in this form of reasoning. Argumentation schemes associated with Bayesian networks are chained back to translate the selected strategy into recipient-adapted messages. Answers

to the user reactions to persuasion attempts are produced after reasoning on the same knowledge base.

- ARGUER (Restificar et al., 1999a, b) focuses on methods, based on argumentation schemata, to detect *attack* or *support* relations among user's and system moves – utterances – during a dialogue. The approach is quite simplified and the dialogue is seen as a simple process of alternate *attack* and *support* utterances between the system and the user (called sometimes *ping-pong effect*).
- The system proposed by Andrè et al. (2000) makes an unusual exploitation of dialogical interactions. It generates presentations that are delivered to the user by teams of communicative agents interacting with each other, rather than addressing the user directly using a single conversational human-like agent, as if it were a face-to-face conversation. In this case the (argumentative) communication is simulated and the user experiences an indirect interaction by "overhearing" the dialogue. The dialogical model is not dynamic, there is a planner that generates a script played by the agents. This approach allows to explore the use of multiple personalities, to express multiple points of view, and to highlight relevant arguments and counter-arguments that in a direct interaction with the user could be missed.
- The system proposed in Andrè et al. (2004) and Rehm and Andrè (2005a) focuses and implements specific aspects and tactics of dialogical and emotional communication, such as politeness strategies (both for verbal (Andrè et al., 2004) and non-verbal (Rehm and Andrè, 2005a) behavior of dialogical agents). In Andrè et al. (2004) a hierarchical selection process for politeness behavior is presented (based on the theory proposed in Brown and Levinson 1987) claiming that attention should be devoted not only to the adaptation of the content to be conveyed but also to stylistic variations in order to improve the users' affective response by mitigating face threats resulting from dialogue acts.
- ARAUCARIA (Reed and Rowe, 2004), an XML-based tool for analyzing and diagramming arguments, focuses on argumentation presumptive schemes (schemes that are defeasible in their nature). The attention is posed on schemes refined with critical questions (Walton and Reed, 2002) to detect or prevent possible user's counter-moves. The model underlying ARAUCARIA is more refined than the ARGUER one but it can be used only for analysis purposes.

The study of these theories/systems enlightened the limits of applying a purely logical reasoning to real domains and the need, on the one side, of considering uncertainty (Zuckerman et al., 2001) and, on the other side, of introducing argumentation schemes more refined than logical *modus ponens* (Walton, 2000).

4.3 Emotional Persuasion Systems

Since emotional reasoning is usually performed in order to modify/increase the impact of the message, affective NLG is strictly connected to persuasive NLG. An annotated bibliography on affective NLG can be found in Piwek (2002). There are

also many computational models of emotion dynamics based on cognitive theories like the one proposed by Ortony et al. (1988). Yet, it is not clear how much of these computational models have been implemented and how much of them are persuasion driven: their focus is on *believability*, for a natural communication with the user (see DeCarolis et al., 2001) or for simulation purposes, rather than on emotions use for an *effective* communication.

- Elliott (1994) presents the affective reasoner multiagent platform for simulating simple emotional "reactions" among groups of agents, depending on personality traits. However, this system does not address persuasion directly since it focuses on emotions dynamics in complex social environments rather than emotions induction for persuasive interactions.
- Carofiglio and de Rosis (2003) focus on emotions as a core element for affective message generation. The implemented model is more complex and more "persuasion oriented" than Elliott's. They use a dynamic belief network for modeling activations of emotional states during dialogical interactions. This model of emotional activation is inserted in an argumentation framework. The main limitations of their approach are the use of only one persuasive strategy at a time – system move – and the fact that they stick to an argumentative view of dialogs: they do not consider the problem of the interaction among different strategies, central in building *complex* persuasive messages.
- de Rosis and Grasso (2000) also focus on affective language generation. Although multimodality aspects are missing, the technological aspects for a "richer" NLG production are addressed, leaving aside emotion simulation needs. Their model uses plan operators – for text structuring – enriched with applicability conditions depending on the user's emotional traits, combined with rule-based heuristics for revising both strategic and tactic planning.
- In Rehm and Andrè (2005b) the focus is on the use of emotional display for particular communicative situations such as social lies and deception. In their work, the authors try to understand how users will react if the information conveyed non-verbally exhibits clues that are not consistent with the verbal part of an agent's action. The virtual agent masks "real" emotions with fake emotions that are inconsistent with the content of the message (based on Ekman's theory (1992). It has been tested both in monological and undialogical scenarios (for the latter, the GAMBLE system is used (Rehm and Wissner, 2005)).
- *Valentino* (Guerini et al., 2008b) is a tool for modifying existing textual expressions toward more positively or negatively valenced versions as an element of a persuasive system. For instance, a strategic planner may decide to intervene on a draft text with the goal of "coloring" it emotionally. When applied to a text, the changes invoked by a strategic level may be uniformly negative or positive; they can smooth all emotional peaks; or they can be introduced in combination with deeper rhetorical structure analysis, resulting in different types of changes for key parts of the texts.

In general we can say that one of the most recent subjects of interest in this trend of research concerns widening the persuasion modes from considering "rational" or "cognitive" arguments to appealing to values and emotional states (Sillince and Minors, 1991; Grasso et al., 2000; Guerini et al., 2003; Poggi, 2005).

4.4 Multimodal Realization Aspects of Persuasion

There is a wealth of research on multimodal aspects of IUI. Many "realizers" can be potentially used in combination with language for emotion displaying/induction. For example

- Embodied conversational agents (ECAs)
- Kinetic typography
- Music
- Use of images

ECAs are synthetic characters (usually human like) endowed with a physical appearance able to display dynamic expressive behavior. Most research has mainly focused on the perceptual interface side.[2] Planning of autonomous behavior led by internal beliefs, desires, and intentions is an open topic of research. Essential elements of ECAs are (1) a *3D model* of the animated agent and (2) a *representation language* for directing the 3D model (usually XML based).

Three dimensional models can be roughly divided in two groups:

1. Just face, e.g., Greta, Xface
2. Face plus body, e.g., EMOTE, PPP Persona

There is a wealth of different representation languages that have different features, partially overlapping, partially differing. These features include emotions expression, deictics specification, RR labeling, personality definition, performative type selection (request, inform, ask). Some of the tasks that these languages can accomplish are

1. speaking ECA (i.e., face), e.g., APML, RRL, SMIL-Agent
2. moving ECA (i.e., face plus body), e.g., XSTEP, MURML
3. interacting ECA, e.g., PML, ABL

Flexibly persuasive ECAs have a large potential as they allow for a richer communication with the user (for an example of a commercial application, see Ach and Morel 2007):

[2] For a survey on existing ECAs and empirical research on their impact see Prendinger and Ishizuka (2003) and Dehn and vanMulken (2000). For further details, please see the final chapter in Part IV.

1. They are "natural" (e.g., gaze can be used for displaying the focus of attention and for turn taking, gestures can be used for deictic references and for contributing to communicative contents). On the importance of eye gaze in ECAs to improve the quality of communication see, for example, the study of Garau et al. (2001).
2. They are more involving (they may include display of emotion and expression of personality). On behavior and emotion displaying there is a plethora of studies, see, for example, Allbeck and Badler (2002) and Poggi et al. (2001). Taking into account also the natural predisposition of humans to treat anthropomorphic agents as human peers, the possibility of ECAs to persuade them – by leveraging social responses – is crucial and critical (for example, making resort to their realism for believability).

Nevertheless the relation between realism and believability on the one side and effectiveness on the other is not totally obvious. In certain situations it is reasonable to use cartoon-like (non-realistic) characters. They can be effective because (a) they do not generate over-attribution that could lead to frustration, (b) they are more suitable for particular kinds of audience, for example, children. When talking about realism and effectiveness we are not just referring to a question of appearance but also of behavior; cartoon-like characters often display exaggerated emotions, obtaining the desired effect. In any case, we should point out that ECAs are not the only resource in persuasive interfaces.

Other resources for emotion empathy and induction are the use of music (Scherer, 1995), the use of kinetic typography (Forlizzi et al., 2003), and so on.

Kinetic typography refers to the art and the technique of expression with *animated* text. Text animation allows adding further dimensions of expressivity to the text and provides it with the ability to display emotions and to capture and direct attention. KT has demonstrated ability to add significant appeal to texts, allowing some of the qualities normally found in film and in the spoken word to be added to static texts. Kinetic typography has been widely and successfully used in film (e.g., opening credits) as well as in television and advertising (e.g., TV commercials, web banners). There are several key areas in which kinetic typography has been particularly successful (Ford et al., 1997; Ishizaki, 1998). These include

- Expression of affective content,
- Creation of characters, and
- Capture or direct attention.

If used in an appropriate way, automated kinetic typography can enhance the emotional impact of the content conveyed by persuasive messages (e.g., hopping words can be used to emphasize a happy message; in Guerini et al., 2007, an attempt to automatically render persuasive messages tagged in APML representation language is presented).

5 Conclusions

In this chapter, we have proposed a view that emphasizes verbal communication capabilities in intelligent user interfaces. Intelligent information presentation systems must take into account the specifics about the user, such as needs, interests, and knowledge; in particular, we think that the emotion dimension and the personality dimension must have a part in individual-oriented and context-aware communication systems. For this purpose, we have discussed persuasive interfaces in particular. These are interfaces that aim at inducing the user – or in general the audience – to perform some actions in the real world. Interfaces of this kind must take into account the "social environment," exploit the situational context, and value emotional aspects in communication. Modeling persuasion mechanisms and performing flexible and context-dependent persuasive actions are much more ambitious than what most current approaches to persuasive technologies aim at (see "captology" (Fogg, 2002)). As opposed to hardwired persuasive features, in this chapter we focused on those systems that have reasoning capabilities able to provide flexible persuasive communication with their users.

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