Persuasive Strategies and Rhetorical Relation Selection

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Abstract. Persuasion is an emerging topic in the field of Human Computer Interaction: persuasion functions will improve the effectiveness of intelligent interfaces. The focus of this paper regards how persuasion affects Rhetorical Relation (RR) selection in the generation of an effective, and context-adapted, message. Using a taxonomy of persuasive strategies, together with a reasoning model, a tree-like structure of the message is generated. By means of selection theorems this structure is then tagged with appropriate RRs. The message structure includes also features for multimodal realization.

1 INTRODUCTION

Persuasion is an emerging topic in the field of Human Computer Interaction: persuasion functions will improve the effectiveness of intelligent interfaces. The emphasis on modeling persuasion mechanisms goes beyond the current focus of "Captology", the term introduced by Fogg [6] with reference to persuasive technologies. Most current approaches on persuasive technologies provide hardwired persuasive features. On the contrary, we are focusing on deep reasoning capabilities for human-computer interfaces (preliminary concepts can be found in [7]). With this prospect we use persuasion mechanisms for Rhetorical Relation (RR) selection in persuasive text structure generation.

To this end, we first introduce a definition of persuasion as a form of action-inducement. Then we sum up the main ideas - at the basis of the systematization of persuasive strategies we have proposed - necessary for RRs selection. This systematization is the core of our system and is obtained by means of: (1) a taxonomy of persuasive strategies and (2) a meta-reasoning model that works on this taxonomy. We show how the system, using the meta-reasoning module, generates an abstract description of the persuasive message. The abstract description has a tree-like structure and its leaves are persuasive strategies taken from the taxonomy. Finally, by means of selection theorems, we account for the interaction between persuasion and rhetorical relations selection. The theorems use predicates related to the taxonomy and allow stating, given a couple of adjacent message sub-trees, which RR can possibly connect them. Recursively applying the theorems, the whole message-tree is tagged with suitable RRs.

We are following a multimodal approach and in our prototype we adopt an Embodied Conversational Agent (ECA), for the realization of the persuasive messages. As a testbed we are concerned with the educational scenario of a museum visit.

2 AN INTRODUCTION TO PERSUASION

Perelman [8] defines persuasion as a skill human beings use in communication in order to make their peers perform certain actions or collaborate in various activities, see also [11]. In our approach, we prefer to narrow this definition by considering action inducement only (while the "large" definition involves behavior inducement).

One of the most well known generation systems that exploited persuasion in communication, focusing mainly on behavior inducement, is STOP . STOP was employed in a real human setting, with the aim at inducing the user to stop smoking but, apart from the problem of assessing a real change in behavior and from the particularly awkward nature of smoking addiction [13], its strategies were context dependent and NLG specific.

The formal definition of persuasion (or better, of persuasive goal), given in (1), uses the idea of Cohen & Levesque of present directed intention ($INTEND_1$) [3], that permits to capture the "narrow" definition introduced above.

$$PERSUADE(x\ y\ a) = GOAL(x\ INTEND_1(y\ a)) \quad (1)$$

The relation between persuasion and dissuasion is non-trivial. In this paper though, we will simply consider "not performing an action" as a form of acting (dissuasion corresponds to persuasion to not perform a given action).

In order to persuade y to perform an action a, x can use arguments concerning a and also concerning actions related to a. Actions can be represented as nodes in a graph. Two basic relations between actions are allowed[2].

1. $Support\ a_1\ a_2$ = the fulfillment of action a_1 helps the fulfillment of action $a2$
$$(SUPPORT\ a_1\ a_2) \quad (2)$$
2. $Conflict\ a_1\ a_2$ = the fulfillment of a_1 endangers the fulfillment of a_2
$$(CONFLICT\ a_1\ a_2) \quad (3)$$
The extreme form of conflict is the one of incompatibility where one action excludes the other. Typical form of incompatibility is the one between a_1 and $\neg a_1$.

There are two general rules that drive persuasion:

1. Every action a_2 that has a support relation with the focused action a_1 can be used to motivate the persuadee to perform it: persuasive strategies on a_2 can be used to persuade on a_1[3].
$$(PERSUADE\ x\ y\ a_1) \wedge (SUPPORT\ a_1\ a_2) \rightarrow (PERSUADE\ x\ y\ a_2) \quad (4)$$

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[2] Here we do not address the problem of objective versus subjective beliefs.

[3] The support relation is a necessary, but not sufficient, condition for using a_2 to persuade to a_1: there are other conditions that must hold for supporting actions to be used to motivate. Among the possible ones: persuader has no goal contrary to y performing a_2.

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2. Every action a_2 that has a conflict relation with the focused action a_1 can be used to dissuade the persuadee to perform it: dissuasive strategies on a_2 can be used to persuade on a_1.

$$(PERSUADE\ x\ y\ a_1) \wedge (CONFLICT\ a_1\ a_2) \rightarrow (DISSUADE\ x\ y\ a_2) \quad (5)$$

3 THE MODEL: A BRIEF DESCRIPTION

In [7] we have proposed a model (taxonomy plus meta-reasoning module), to provide a categorization of a rich repertoire of persuasive strategies coming from social psychology, philosophy, and so on (see for example [4] [10] [12]). In this model, that account for the interaction among strategies, the focus is on the four following aspects: (1) The cognitive state of the participants (2) their social relations (3) their emotional state (4) the context in which the interaction takes place.

Other systems, such as those proposed in [15] or [2], use argumentation strategies in the generation of persuasive messages, but the focus is different. Zukerman [15] 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*). Our categorization, instead, is strictly dependent on the content of the strategies with relation to the above aspects. Logical reasoning to support persuasion is just one resource (that here we shall not discuss further) to induce someone to act. Carofiglio and de Rosis [2] focus on some of the elements of persuasion we outlined (i.e. emotions), but they do not consider the problem of the interaction among different strategies, central in building complex persuasive messages. In their model, since their main concern is dialogical argumentation, only one strategy per time can be used during a persuasive interaction.

The aim of the hierarchy we propose (see Fig. 1) is to provide a classification framework that accommodates a good number of strategies as a basis for computational treatment. Three main classes have been individuated: *belief-inducement*, *action-inducement* and *object-features*.

Belief Inducement Strategies: strategies that are concerned with x's effort to enhance the probability of y accepting the content conveyed. Examples are: *appeal to expert opinion*, *appeal to popular opinion*, and *appeal to empirical evidence* [14].

Action Inducement Strategies: strategies concerned with x's effort to induce y to perform action a. Under this category there are two other sub-categories: the one involving "goal balance", the one involving "supporting belief" [3]. In particular, in *goal balance* strategies x can persuade y to perform action a using strategies on positive consequences. Instead, using strategies on negative consequences, x can dissuade y to perform a. Consequences are defined as "positive" or "negative" with reference to y's goals. *Supporting belief* group: strategies concerned with information regarding the possibility to perform the required action (e.g. *can-do*, *know-how*, etc.).

Object features Strategies [1]: strategies that are concerned with the features of the object involved in the action. Using features that x believes are attractive from y's point of view, x can increase the probability that y performs the required action: as for goal balance, positive features are used to persuade, negative ones to dissuade.

Some strategies have a typical meta-reasoning form: meta-strategies carry out different tasks to handle the applicable persuasive strategies in the generation of a persuasive message. These tasks are: content ordering, selection and modification. Since our concern is on message-structure generation, we limit our analysis to content ordering. Two examples of strategies that are concerned with content

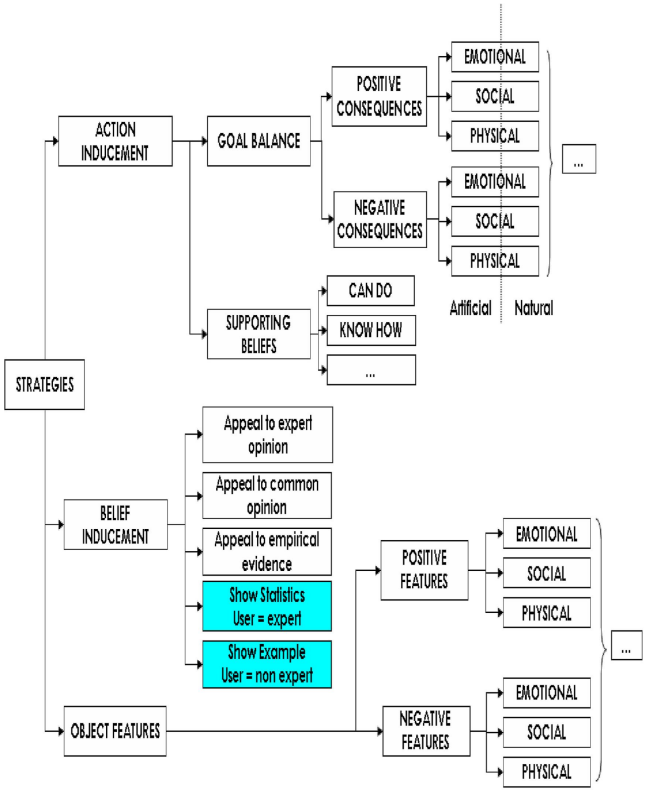

Figure 1. The taxonomy of persuasive strategies

ordering, in persuading y to do a, are:

a) *Support* meta-strategy: "If there is a strategy $S1$ the system can use and its persuasive force is too low and there is a strategy $S2$ on belief inducement which content is $S1$, then the system can use $S2$ to increase the persuasive force of $S1$"

b) *Resort to fear* meta-strategy: "If there are positive consequences of a the system can show and there are negative ones of a conflicting action as well and the user is impressionable, then the system can put the negative consequences of the conflicting action first to enhance the persuasive force of the message"

Content ordering meta-strategies can interact with each other in order to create a complex strategies-tree (an abstract description of the persuasive message composed of several strategies).

4 STRATEGIES AND RR

In text planning, a widely used reference theory is the one proposed by Mann and Thompson. This theory, called Rhetorical Structure Theory (RST) [8], 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), accounts 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). The relations that connect spans with different importance are called hypotactic, instead those relations connecting spans with the same importance are called paratactic. In this work we use the formalization of RST given by Marcu [9].

The relation between persuasive strategies and RR can take place at

two levels. At the macro level the RRs connect different strategies, while, at the micro level, the RRs articulate the content of a single strategy. In this work, we focus on the macro-level and in particular on the issue of generate a discourse tree out of the strategies tree.
In our approach a persuasive strategy can be seen as an atomic constituent (elementary unit) and, by means of selection theorems, we identify the RR connecting adjacent elementary units, along with the nucleus of the resulting span.
These theorems are also used for extended-RRs: the Extended Theory of RR derivation, by means of the concept of "promotion" of a segment, claims that what holds between elementary units holds also between larger and more complex spans. According to RST formalization proposed by Marcu, the promotion of a segment is always an elementary unit (a persuasive strategy in our framework). In this way selection theorems can be recursively applied, ending up with a RR-tree. Therefore, according to extended RRs framework (and following the assumption of binary branching of the RR-Tree), in deciding which RR can hold between two spans of any complexity, selection theorems consider:

1. the type of the promotions of the two spans (w.r.t. the taxonomy)
2. the content of the promotions of the two spans

For the sake of simplicity we allow selection theorems to choose only one RR for every pair (i.e. only the most appropriate RR has to be chosen).
A logic based on the one proposed by Marcu, extended with new predicates, is used to model the theorems.
Marcu Predicates:
T(l, h, relation_name) = denotes the name of the RR that holds between the text spans that are immediate subordinates of span$_{l,h}$ in the text tree.
S(l, h, status) = denotes the status of span$_{l,h}$ (NUCLEUS, SATELLITE, None).
P(l, h, unit_name) = denotes the set of units that are salient for span$_{l,h}$ and that can be used to connect this text span with adjacent text spans in the final RS-tree.
New Predicates:
TYPE_OF(S,C) = returns T if the strategy S belongs to the class C or to a sub-class of it; F otherwise.
CONTENT(S,P) = returns T if the content of the strategy S is P.
PERSUASIVE-FORCE(S) = is a function that returns a numeric value.
In the following we use variables $S1$ and $S2$ to denote any two arbitrary adjacent text spans. So span$_{l,h}$ = $S1$ and span$_{h+1,k}$ = $S2$ (or vice-versa) where l<h<k.
We now introduce the assumptions of the outlined framework, necessary for the selection theorems. Then we introduce the general structure of the selection theorems along with some examples.
Assumptions:

1. a promotion is always a strategy, never a complex unit
2. by definition, leaves - elementary units - are always strategies
3. by definition, the promotion of a leaf is the strategy itself
4. for paratactic relations the promotion of a span is always the most important (max. persuasive force) promotion of the two sub-spans
5. for hypotactic relations the promotion of the new span is always the promotion of the nucleus

The general structure of selection theorems is composed of two parts: $applicability\_conditions$ and $result$. The $applicability\_conditions$ part is composed of a test on the type_of the promotion of the involved spans and a test on the content of the promotion of such spans. An optional part, referring to the persuasive force of such spans, is used, in some theorems, as a test of felicity conditions. The $result$ part is composed of the delineation of the RR holding between the two spans and the delineation of the nucleus of the resulting span.
Two examples of selection theorems are shown here below (the promotion can be derived by means of assumptions 4 and 5)
T-evidence:

$$\begin{aligned}&\forall S1, S2: \\ &[(TYPE\_OF(P(S1),\ belief-inducement) \wedge \\ &TYPE\_OF(P(S2),\ Strategy) \wedge \\ &CONTENT(P(S1),\ positive-opinion(p,c)) \wedge \\ &CONTENT(P(S2), c)) \rightarrow \\ &(T(S1,\ S2,\ JUSTIFY) \wedge S(S2,\ NUCLEUS))]\end{aligned} \quad (6)$$

"If the type of the promotion of span $S1$ is belief inducement and the content of the promotion of $S1$ is an opinion regarding the content of the promotion of $S2$ then the RR that links the two is a justification relation and the nucleus of the new segment is $S2$."
T-contrast:

$$\begin{aligned}&\forall S1, S2: \\ &[(TYPE\_OF(P(S1),\ show-neg-cons) \wedge \\ &TYPE\_OF(P(S2),\ show-pos-cons) \wedge \\ &CONTENT(P(S1),\ a_1) \wedge \\ &CONTENT(P(S2),\ a_2) \wedge (CONFLICT\ a_1\ a_2)) \rightarrow \\ &(T(S1,\ S2,\ CONTRAST) \wedge S(S2,\ NUCLEUS))]\end{aligned} \quad (7)$$

"If the type of the promotion of span $S1$ is show negative consequence and type of the promotion of span $S2$ is show positive consequence and the content of the promotions are two conflicting actions then the RR that links the two is a contrast relation and the nucleus of the new segment is $S2$."

5 AN EXAMPLE

In our museum scenario (an intelligent interface agent that assists the visitor through the visit) the interface agent can have a goal such as: "make the user pay attention during the visit"

$$GOAL(x\ INTEND1(y\ a)) \quad (8)$$

where *x = interface; y = user; a = PAY-ATTENTION(y visit)*. Given $(CONFLICT\ \ a\ \ \neg a)$, a *Resort to Fear* and a *Support* meta-strategies may have generated the strategies-tree $((S1, S2), (S3, S4))$ (see Figure 2).

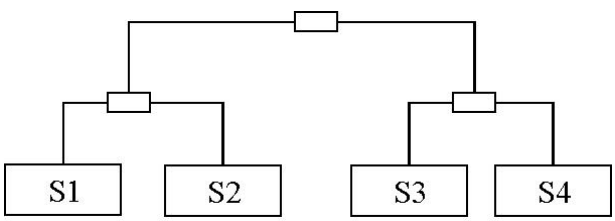

Figure 2. The strategies-tree of the message

Where:
TYPE_OF(S1, appeal-expert-opinion) : "As Umberto Eco says"
TYPE_OF(S2, show-neg-consequences(a)) : "If you don't pay attention during the visit, you will miss a good opportunity to appreciate some of the best Medieval paintings"
TYPE_OF(S3, show-social-pos-consequences(a)) : "If you pay attention your mother will be happy"
TYPE_OF(S4, show-artificial-pos-consequences(a)) : "I will print a report of your visit you can bring home for your mother"
Appropriate theorems produce the tags for RRs connecting the segments:

1. *T-evidence: T(S1, S2, EVIDENCE)*
2. *T-conjunction: T(S3, S4, CONJUCTION)*[4]
3. *T-contrast: T((S1,S2), (S3,S4), CONTRAST)*

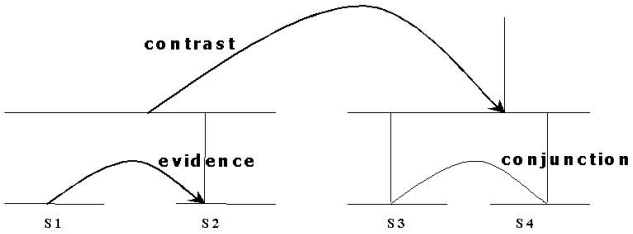

Figure 3. The structure of the produced sentence

This produces a text span (see Fig. 3 for text structure) rendered as, for example: "**As** Umberto Eco says, if you don't pay attention during the visit you will miss a good opportunity to appreciate some of the best Medieval paintings. **Instead**, if you pay attention, your mother will be happy **and** I will print a report of your visit you can bring home for her".

6 CONCLUSION

Persuasion is an important theme for the development of intelligent interfaces. In this paper we have described how persuasion mechanisms can be used in Rhetorical Relation selection for text structure generation. To this end we have defined persuasion as a form of action inducement and summed up the basic elements for computational treatment (a taxonomy of persuasive strategies and a meta-reasoning model). Then we have proposed a set of selection theorems that, using predicates related to the taxonomy, allow stating which RR can be associated to every part of the message.
We are currently working at generalizing the selection theorems by adding the persuasive goals of spans. Moreover, since our model set up specification regarding the mood to be conveyed with every part of the message, the resulting rhetorical structure can be usefully combined with these specifications for a multimodal realization of the messages. For instance, we can use a talking head to express the mood of the message, or a music theme to emphasize a given emotional aspect, or combine the text with salient images and so on. Specifically we are currently working at connecting our prototype version (see [7] for further details) with a talking head, using APML (see [5]) as a specification language. In this way, we can convey information regarding, for example, the emotions to be expressed along with the message.

[4] This theorem says that if the promotions of the two spans belong to the same class and both promotions have the same content then the RR connecting the two spans is a conjunction.

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