Combining Logical with Emotional Reasoning in Natural Argumentation

V. Carofiglio

Intelligent Interfaces,
Department of Informatics
University of Bari, Italy
carofiglio@di.uniba.it

F. de Rosis

Intelligent Interfaces,
Department of Informatics
University of Bari, Italy
derosis@di.uniba.it

Abstract

We discuss how emotions may affect shallow and inner forms of intelligence by considering, in particular, the case of argumentation. It has been proved that 'natural' argumentation system should be endowed with the ability to provide burdens of proof as well as dialectical arguments, that are not necessarily based on the rationality and validity of proofs. We describe an ongoing project, in which we model argumentation knowledge and emotion activation in intelligent agents with the formalism of belief networks. The two knowledge sources are combined to assess the rational and emotional strength of candidate strategies and to adapt selection of the 'most promising strategy' to the scale of values and the personality of the message receiver.

1. Introduction

Affective factors influence argumentation in several directions. They may influence argument strength by appealing to the receiver's emotions and highly placed values (Sillince and Minors, 1991) and may affect, at the same time, the way argument structures are formulated by the proponent (Wegman, 1988). A 'natural' argumentation system should therefore be endowed with the ability to provide burdens of proof as well as dialectical arguments, that is arguments that are not necessarily based on the rationality and validity of proofs. This view is compatible with the Elaboration Likelihood Model, according to which effectiveness of persuasive communication is due to a process that follows two different paths induced by communication (Petty and Cacioppo, 1986). The first one is the *central route*: this assumes that people are more likely to be persuaded if they are able to elaborate extensively on the message received. If they are motivated to think about the message and the message is a strong one, they will be persuaded accordingly: in this case, the 'rational' aspect of argumentation is the central topic. Instead, the argumentation through the *peripheral route* assumes that, even if a person is unable to elaborate on the message extensively, he may still be persuaded by factors that are only indirectly related to the content of the message itself. These factors (for instance, the perspective of consequences) induce some attitude change in the receiver of the argumentation message, as result of the activation of some emotion or the recall of some highly placed value. This view is elaborated in Poggi's (1998) goal and belief model of persuasion, in which she describes two ways in which the receiver's goals may be influenced: emotion triggering and goal hooking.

Let us consider a still topical claim: *"In the closing stages of the Gulf War between a UN-backed force and Iraq, the UN-backed force should have pressed on to Bagdad and thus ensured the complete overthrow of Saddam Hussein"*. (Sillince and Minors, 1991).

In the cited paper, a list of arguments 'for' and 'against' this statement are listed, which appeal to various kinds of emotions. Two examples:

Ex 1: an argument 'for' with appeal to fear: *"If we leave Saddam with a nuclear and chemical weapons capability he may hit back at some time in the future"*.

Ex 2: again an argument 'for', with appeal to hope: *"Once Saddam has been replaced and democratic institutions set up in Baghdad, the problems of the region will be over"*.

Theorists of argumentation do not agree on how this form of argumentation should be considered. To Sillince, emotions and highly-placed values are among the factors that influence the strength of arguments: the manipulation and processing of emotions and values should therefore be part of automatic generation of 'good' arguments. Marcus

(2000) mentions assuming the hearer as a purely 'logical' agent as one of the fallacies of present persuasive communication attempts. Gilbert (1994) claims that 'arguments invariably include non-logical components essential to their proper understanding'. Others, on the contrary, tag these arguments as 'logically irrelevant' although they 'may succeed in evoking an attitude of approval for oneself and what one says' (Walton, 1999). This is, in our view, one of the domains in which purely logical reasoning must be integrated with consideration of emotional and value factors, to achieve some degree of naturalness in the message generated (Lisetti and Gmytrasiewicz, 2002).

In this short paper, we show how a 'natural' argumentation system may be built by combining appropriately the two forms of reasoning and by selecting the arguments which best suit the user characteristics. We describe the formalism that we employ to represent knowledge involved and to simulate argument selection strategies. We demonstrate the first results of this ongoing Project and organize our contribution according to two questions proposed for the Workshop.

2. Argumentation Modeling

Several authors dealt with the problem of simulating reasoning behind argumentation, by applying the model proposed by Toulmin longtime ago (Toulmin, 1958). According to this model, a *claim* may be supported by presenting one or more *data*: these data act as variables that may be accepted in the scope of a *warrant*; they are evidences supporting the claim with a given degree of strength (specified by a *qualifier)*. The power of the warrant may be decreased or increased by introducing a *rebuttal* or a *backing of warrant*.

Some argumentation systems employed logic to represent knowledge and reasoning (for instance, Grasso et al, 2000). Others proposed representing uncertainty to measure the 'strength' of arguments and to model selection of 'optimal' strategies in particular contexts (Zukerman, 1999). Recently, interest towards natural argumentation encouraged considering affective factors and scale of values of the interlocutor in modeling selection of the best strategy (Reed and Grasso, 2001). Consideration of these factors requires defining a method for representing the cognitive and affective state of the interlocutor. It requires, as well, enriching argumentation graphs with knowledge needed to consider the affective impact of arguments.

3. Some Answers To The Workshop Questions

Q1: How to model emotional states and attitudes

We justified elsewhere our choice of dynamic belief networks as a formalism for representing personality and context-based emotion activation (de Rosis et al, in press). In the cited paper, we showed how the emotional state of an Embodied Animated Agent may be manifested through face and voice expression. In another paper, we showed how emotions may influence the dialog between the agent and a user, by contributing to dynamic revision of the priority of discourse goals (Cavalluzzi at al, 2003). In this contribution, we describe an ongoing development of that research project, which is aimed at simulating, in particular, *appeal to emotions and highly placed values* in the persuasive section of the dialog. We first summarize the main aspects of our emotion modeling method, to then describe the argument selection strategy.

Let us denote with P the *proponent* of an argument and with R its *receiver*, that is the person to which the argument is addressed. Our model of activation of emotional states in R is represented with a Dynamic Belief Network (DBN). As proposed by Nicholson and Brady (1994), we use DBNs as goal monitoring systems that employ the observation data in the time interval (T_i, T_{i+1}) to generate a probabilistic model of the receiver's mind at time T_{i+1}, from the model that was built at time T_i. We employ this model to reason hypothetically about the consequences of an argument on the monitored goals of the receiver.

Let us consider the triggering of *hope* that is shown in figure 1[1]. Hope is a 'positive' emotion which is triggered by a change in the belief that the goal of *Getting-future-good-of-self* will be achieved. The intensity of this emotion is influenced by the following cognitive components:

- the receiver's belief that an event x will occur to self in the future Bel_R *Ev (Occ R x)*;
- the belief that this event is desirable: Bel_R *(Desirable x)*;
- the belief that this situation favours achieving the agent's goal*:* Bel_R *(Ach-FutGoodSelf)*

The emotion of *fear* is triggered by a similar cognitive mechanism, when some of the BN nodes involved have opposite sign because the occurring

[1] The network includes two symmetrical components, at times T_i and T_{i+1}. Due to space limits, we show in the figure only the component at time T_{i+1}, with the link to the monitored goal at time T_i.

event is *undesirable*. The goal involved is, in this case, *Preserving-self-from-future-bad.*

According to the utility theory, we calculate *the variation in the intensity of an emotion* in the receiver R as a function of the product of the change in the probability to achieve a given goal, times the utility that achieving this goal takes to R.
Q2: How should user emotions and attitudes be used to enhance HCI?

To get internal consistency in the representation of knowledge sources employed in our argumentation system, we model also the argumentation knowledge by means of a belief network. To formalize the various aspects of Toulmin's models, we add some semantics to these networks by representing, in their nodes, not only data and claims but also warrants (in *warrant-nodes*). This gives us the opportunity to represent *backings of warrant* by chaining back on these nodes. Figure 2 shows, for instance, the warrant of 'appeal to expert opinion' (Kienpointner, 1992) with its backing.

The backing of warrant is a domain-dependent rule. Unification of a general rule (the warrant) with an instantiated one (the backing of warrant) allows chaining and defines a degree of applicability of the warrant in the considered context. Our argumentation-BN also includes *Proof-Nodes*, which enable us to represent multiple warrants concluding on the same claim. By associating *weights* with warrant-nodes according to the receiver's scale of values, we can simulate selection of argumentation strategies by appeal to the receiver's highly placed values. Explicit representation of warrants may be useful, as well, for translating selected strategies into natural language messages.

When logical and emotional argumentations are combined, the strength of an argument depends not only on its rational impact and its plausibility, but also on the strength of emotions the argument triggers in the receiver. For example: arguments aimed at getting a receiver to adopt a recommended course of action by appealing to hope or to fear have the structure of *arguments from (positive or negative) consequences*. They try to persuade the receiver to accept (or reject) the truth of a proposition by citing the consequences, for R, of accepting (or rejecting) that proposition (Walton, 1992). Figure 3 shows the BN representing this argument, when a positive consequence g of doing an action a is mentioned and therefore the purpose is to persuade Ag (R in our case) to perform a (as in Ex1, in the Introduction).

Modeling knowledge about emotions and about argumentation strategies by means of BNs enables us to evaluate whether the argument is plausible and whether it produces, at the same time, the desired rational and emotional impact. In the example about the Iraq war, we may assess whether conditions for triggering fear or hope (at a desired degree of intensity) are satisfied in a given context and with the given interlocutor.

To evaluate every candidate argument the system might present to the receiver, a simulative reasoning is applied to the argument graph which is in focus in the current phase of the dialogue, by guessing the effect this candidate might produce on the receiver. We call *IM-S-R* the second-order belief network that the system employs in this simulative reasoning.

4. An Example Dialog

Let us consider an example dialog in the domain of 'advice about eating disorders'[2] and let us denote with Si the system moves and with Uj the user moves.

S1: You should eat more vegetables. Eating sufficient quantities of vegetables may help to protect you against a number of dreadful illnesses, keeping you free to enjoy a long life.

U1: Who says that?

S2: The British Food Standard Agency.

U2: But is the FSA a good source of experience in this domain?

S3: Yes it is! It is a competent and trustful source.

U3: But my father is a vegetarian and he is not in good health.

S4: Of course, there are exceptions. But chances are increased considerably.

U4: But I like salami and don't care being in good health!

S5: I'm surprised! Still, you don't smoke and make regular physical activity!

U5: True. But I'm doing it for aesthetic reasons.

S6: Oh, I understand now! But eating vegetables is important also to have an attractive aspect.

…etc

In this dialog, the selected strategy is *appeal to positive consequences;* figure 4 shows the emotion

[2] This is the domain we considered in the scope of the EC-funded Project MAGICSTER (IST-1999.29078) which partially supported this work.

and argument-BNs that may be employed to simulate reasoning behind it. The system wants to persuade the user to eat vegetables: *ShouldDo R EatVeg*. It selects, among the strategies it knows, those having a good 'rational impact' by exploiting data in which the user presumably believes. It then tests the emotional impact of arguments it might employ (for instance, appeal to hope as in our example, or to fear) by applying a simulative reasoning on IM-S-R, as shown in **figure 4**. That is, it asks itself: "Is U more sensible to arguments evoking positive or negative consequences of eating vegetables?". The answer to this question depends on the presumed 'personality' of the user, which is represented (as we said) in terms of utility assigned to achieving the node goal in the figure. Once (as in our example dialog) appeal to hope has been selected, the system further decides whether to recur, in its argumentation, to the value 'having a good appearance' or 'being in good health'. By propagating in the network the data it knows about the user (she does not smoke and makes sport), it selects the second alternative (Proof 2 in the figure) as this appears to be more likely.

Users may respond to the message produced by the system with *critical questions* of various kinds: about the *data*, about the *qualifier* or about the *backing of warrant.* They may also introduce *rebuttals* to weaken the system argument. In our example, at move S1 the system introduces the argument supporting Proof2. At moves S2 and S3, it answers to further questions by exploring backward the BN. At move S5, it understands that its initial hypothesis about the user's scale of values was not correct and that appearance is more important, to the user, than health. It then explores the strategy bringing to Proof1 and carries on the dialog with this new strategy.

A strategy based on *appeal to fear* would bring, on the contrary, to a move S1 of the type:

S1: You should eat more vegetables. Not eating appropriate daily amounts of fruits and vegetables increases significantly the risks of potentially fatal and tragic illnesses such as heart diseases and cancer. You are also less protected against flu and other infections….

5. Conclusions

We have still to clarify a number of problems before producing a system that simulates the subtleties of emotional argumentation. We suspect that even the line separating 'rational' from 'emotional' arguments is not clear and depends on the proponent's beliefs about the receiver: we found difficulties, in some cases, in categorizing an argument as 'rational' or 'emotional'. But we believe that this is a good reason to claim that a natural argumentation system cannot do without considering emotional factors.

Acknowledgements

After we submitted this paper, we had extended discussions about emotional persuasion with Cristiano Castelfranchi, Maria Miceli and Isabella Poggi: we owe to these discussions and to insightful comments by one of the reviewers a number of hints on how to revise our original ideas.

6. References

Cavalluzzi, A. , De Carolis, B., Carofiglio, V. and Grassano, G. (2003). Emotional dialogs with an embodied agent. *Proceedings of User Modeling '03*. Springer LNCS

de Rosis, F., Pelachaud, C., Poggi, I., Carofiglio, V. and De Carolis, B. (in press). From Greta's mind to her face: modelling the dynamics of affective states in a Conversational Embodied Agent. In *International Journal of Human-Computer Studies.*

Gilbert, M.A. (1994) What is an emotional argument? Or Why do argument theorists quarrel with their mates? *ISSA Conference.* June.

Grasso F., Cawsey A. and Jones R, (2000): Dialectical argumentation to solve conflicts in advice giving: a Case Study in the promotion of health nutrition. *International Journal of Human-Computer Studies,* 53 (6).

Kienpointner, M. (1992) How to Classify Arguments. *In Argumentation Illuminated*. F.H. van Eermeren, R.Grootendorst, J.A.Blair, C.A.Willard (eds.), pp.178.188.

Lisetti, C.L. and Gmytrasiewicz, P. (2002) Can a rational agent afford to be affectless? A formal approach. *Applied Artificial Intelligence*. 16, 7-8.

Marcu, D. (2000) Perlocutions: The Achille's heel of speech acts. *Journal of Pragmatics.*

Nicholson, A.E. and Brady, J.M. (1994). Dynamic belief networks for discrete monitoring. *IEEE Transactions on Systems, Men and Cybernetics*, 24,11.

Petty, R.E., Cacioppo, J.T. (1986) The Elaboration Likelihood Model of Persuasion. *Advances in Experimental Social Psychology*. L.Berkowitz (Ed.), 19, pp. 123-205, Academic Press.

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

Poggi, I. (1998). A goal and belief model of persuasion. *6th International Pragmatics Conference*.

Reed, C.A. and Grasso, (2001) F. Computational Models of Natural Language" in Alexandrov, V. et al. (eds) Proceedings of the *International Conference on Computational Science* (ICCS2001), Springer Verlag, San Francisco.

SillinceJ.A. and Minors,R.H. (1991). What makes a strong argument? Emotions, highly-placed values and role-playing. *Communication and Cognition*. 24, 3-4.

Toulmin,S.T. (1958). *The uses of argument*. Cambridge University Press.

Walton,D.N. (1999) Dialectical relevance in persuasion dialogue. *Informal Logic*. 19, 2-3.

Walton, D.N. (1992). *The place of Emotions in Argument*. Penn State.

Wegman,C., (1988). Emotion and argumentation in expression of opinion. In V Hamilton, G H Bower and N H Frjida (Eds): *Cognitive perspectives on emotion and motivation*. Kluwer.

Zukerman,I., McConachy,R., Korb, K., D.Pickett. (1999). Exploratory Interaction with a Bayesian Argumentation System. *XVI IJCAI*, pp. 1294-1299, Stockholm, Sweden. Morgan Kaufmann Publishers.

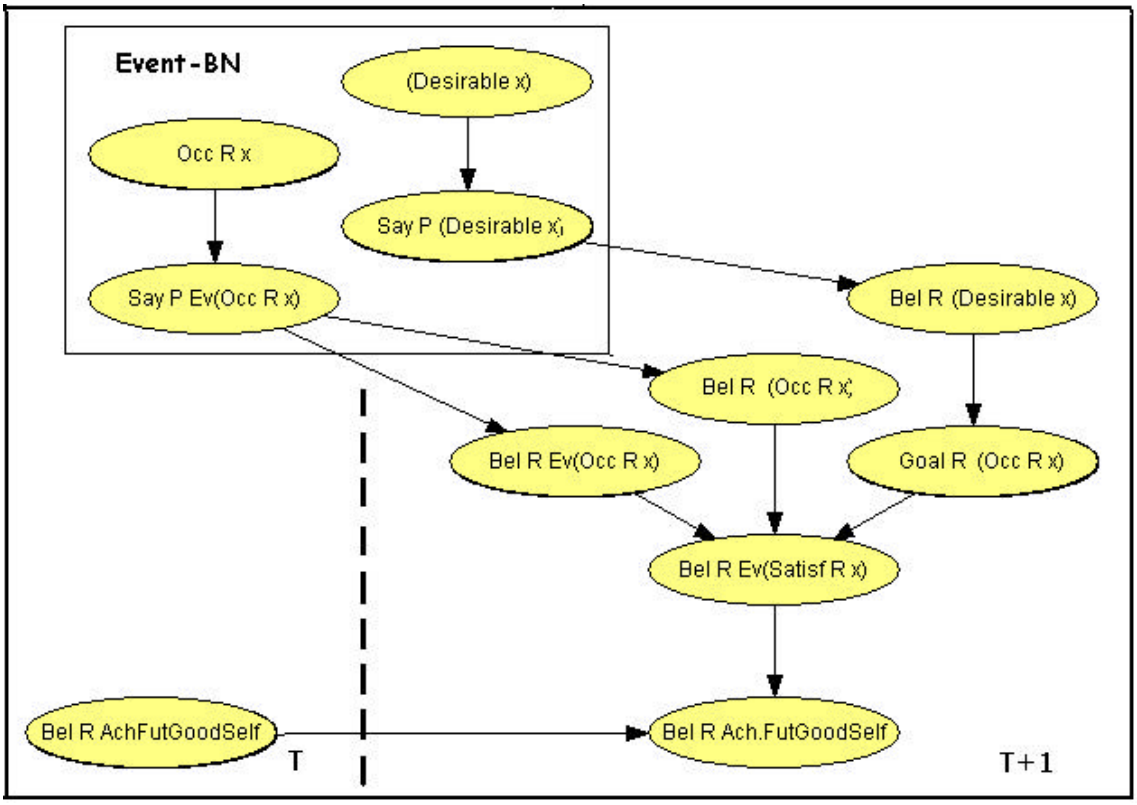

Fig. 1: activation of *hope*

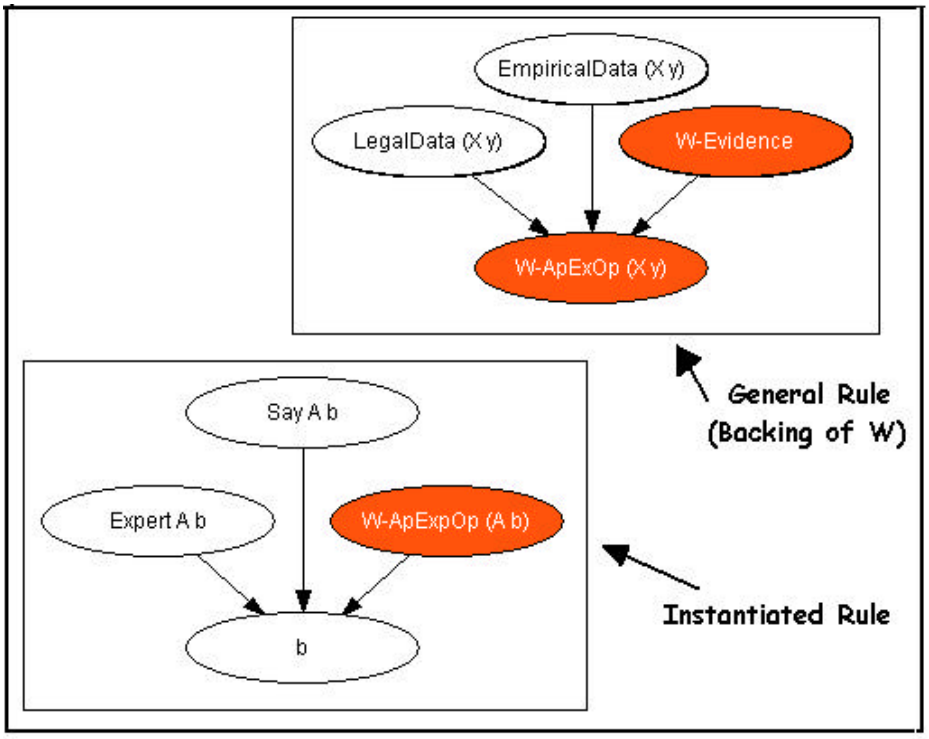

Fig.2: The *Appeal to Expert Opinion* warrant, with its backing

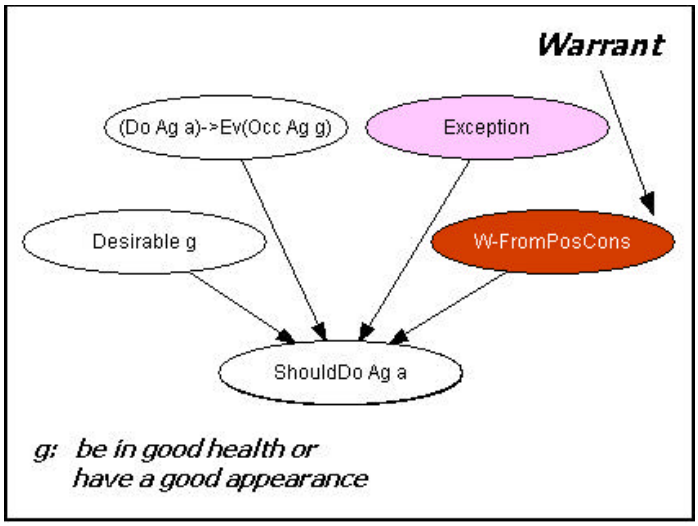

Fig. 3: the *Appeal to positive consequences* warrant

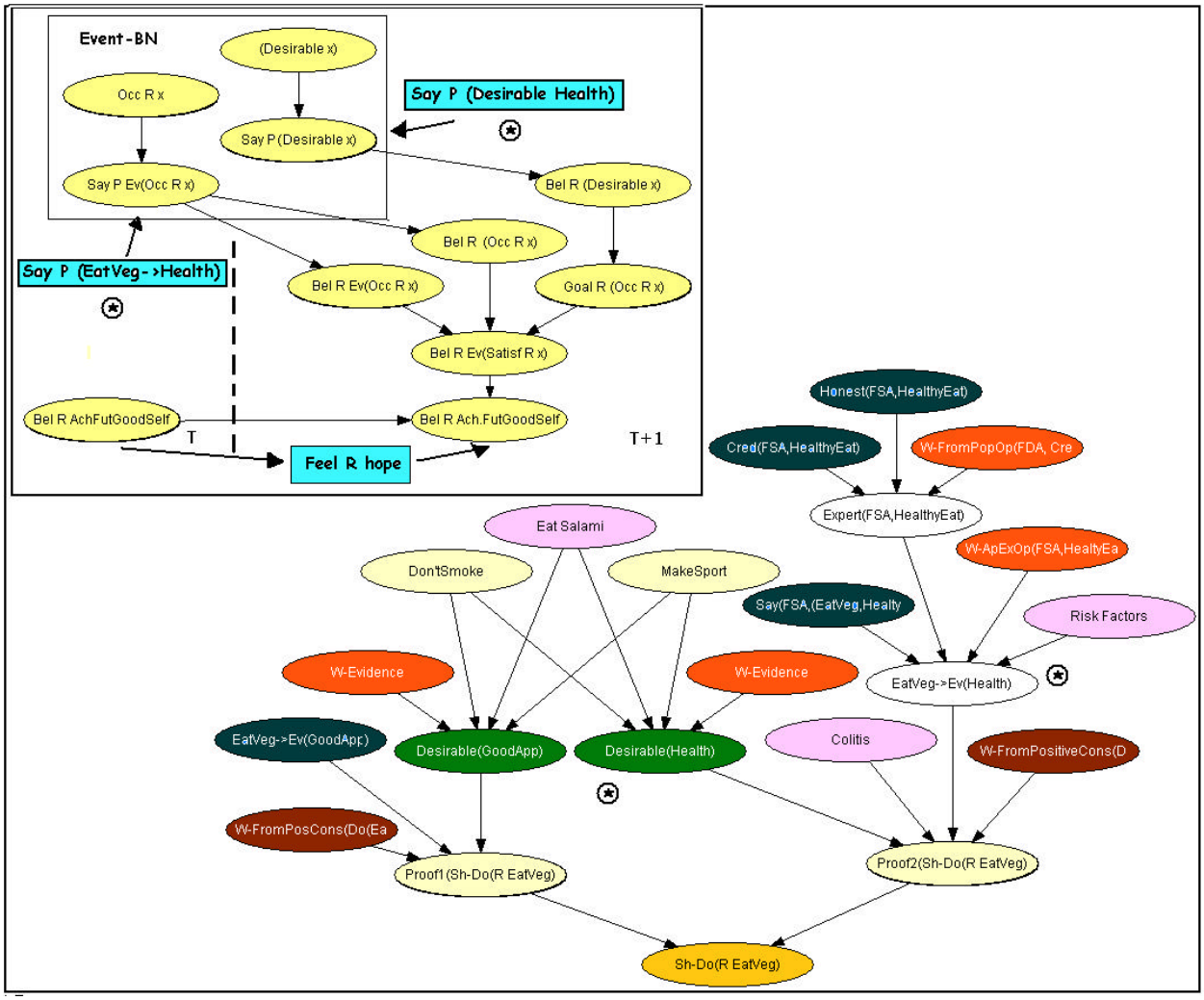

Fig. 4: Combining an argumentation-BN with an emotion-activation-BN