Towards the Model of Central and Peripheral Arguments

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Abstract. The paper lays foundations for the computational model of persuasive argumentation. It is inspired by the elaboration likelihood model (ELM) proposed by Petty and Cacioppo. The ELM is one of the most influential contemporary theories of persuasion in social psychology. It assumes that there are two routes to persuasion and two types of persuasive means (arguments): central and peripheral. The central route to persuasion (CR) is related to content-based arguments, while the peripheral route (PR) is related to unsubstantial kind of impact, such as credibility or attractiveness of the source of information.

1 INTRODUCTION

In most of the cases, natural arguments have a persuasive function, i.e. they are put forth to make others believe or do something. Therefore, in real-life practice argumentation combines aspects related to the logical structures of reasoning with the rhetorical (persuasive) aim of its performance. While in theory of argumentation the structure of arguments is well studied (see e.g. [17, 12, 20, 11]), their persuasive nature is less explored. Moreover, the analysis of communication in natural contexts requires models which determine not only how to *correctly* build argumentation (such as models provided by logic-oriented theories), but also models which allow to reconstruct messages adequately to how people *actually* build arguments (such as models based on psychological theories). Such analysis shall start with a psychology-based type of model, which would enable to reconstruct components that people actually identify in a communication. Next step would be to use a logical model which allows to evaluate this message. In particular, we could analyze if arguments support a claim in the satisfactory degree, if sources of information can be trusted, etc.

As a result, there is a need to combine logical approaches with theories of persuasion. Theory of argumentation exploits some elements of rhetoric. Computational models of arguments (such as e.g. ARGUMED [19], Araucaria [15], the AIF [4], ArgDF [14] or Avicenna [13]) find particularly important the concept of argumentation schemes which corresponds to the classical idea of *topoi* [1]. However, there have not been many attempts to use theories of persuasion, which has been developed more recently. The rich source of such theories is social psychology (see [6] for an overview). To the best of the author's knowledge, the only model that directly links computational approach with social psychology is the model inspired by cognitive coherence theory proposed by Pasquier *et al* [7]. Cognitive coherence is used to represent the cognitive aspects of communication through the concept of attitude change which captures the persuasive aspect inherent to each types of communication including argumentation.

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This paper considers the possibility of exploiting another theory from social psychology in the computational models of natural argument. The elaboration likelihood model (ELM) proposed by Petty and Cacioppo [8] is one of the most influential contemporary theory of persuasion. The ELM proved its importance as a theory which allowed to explain the inconsistency in the results of experiments. Other psychological models assumed one route to persuasion and one type of persuasive means (arguments). The ELM suggested that there are two routes and two types of means: central and peripheral. The two-route theory turned out to predict the results of experiments more adequately. It showed why one factor was important in some experiments, while in others it played insignificant role. In fact, the significance of a factor depends on the route which is activated in the particular experiment.

The central route to persuasion (CR) is related to content-based arguments, while the peripheral route (PR) is related to unsubstantial kind of impact, such as credibility or attractiveness of the source of information or the influence on emotions of the receivers (audience). In the CR, the outcome of persuasive effort is the result of the receiver's thoughtful consideration of issue-relevant material of the message. When the CR-processes are engaged, the quality (strength) of arguments' content is likely to influence persuasive success. On the other hand, in the PR the outcome of persuasion is the result of less thoughtful processes, such as some heuristic (a simplifying decision rule). The persuasive success is influenced by cues other than an argument's content, e.g., the receiver might reach a conclusion based on the communicator's credibility or likeability. In consequence, the PR-arguments, e.g. built upon someone's credibility, were an important factor in the experiments, in which the peripheral route was activated, while it was insignificant in those cases, in which the central route was dominant [10].

The likelihood that a receiver will engage in elaboration (issue-relevant thinking) depends on the elaboration ability (such as e.g. prior background knowledge or the presence of distraction in the communication setting) and the elaboration motivation (such as e.g. the receiver involvement, i.e., the personal relevance of the issue). For example, when an issue is not involving and there is some distraction present, the receiver may rely on PR-arguments such as the communicator's expertise. In such a case, high-credibility communicators will be more successful than low-credibility communicators. On the other hand, when the issue is personally relevant, the quality of argument content will become more important.

The usage of the PR-arguments has both strengths and weaknesses. First, they allow societies to function efficiently. For example, the PR-arguments based on the mechanism of authority enables to create the hierarchy in a society, which in turn enables to develop complex systems of production, defence, etc. [5]. The peripheral route is also beneficial from the point of view of an individual agent. It allows him to save time, energy and his "mental resources" in pro-

cessing information he receives. Nowadays, peripheral arguments are especially (and will become even more) important, since the pace of life is so fast and the amount of messages received is so high that it makes processing all of messages in the central route impossible. However, the peripheral route has also some disadvantages. It is particularly susceptible to manipulation. The receivers do not fully control peripheral cues, since they are automatic ("subconsciously driven") social means of influence. Thus, it is especially important to support the skills of identifying and evaluating the elements related to the peripheral route to persuasion.

The main tasks of the paper are: (1) to bridge the gap in modeling persuasive argumentation bringing together traditions of informal logic, philosophy and social psychology, (2) to extend the model of argumentation with the components specific for persuasive functions of communication.

The paper is organized as follows. Section 2 presents a basic framework for persuasive argumentation. Section 3 proposes the specification in the AIF language. And Section 4 discusses the characteristic properties of central and peripheral arguments.

2 BASIC FRAMEWORK

One of the tools used to represent and analyze argumentation is the graph-theoretic method of argument diagramming [17]. In this section, I show how this method can be applied to represent persuasive argumentation inspired by the ELM. I specify the model only for the relation of support between arguments. In the future work, I want to enrich this account with the relation of attack.

Let D be a digraph (directed graph) (V, E) representing the *network of persuasive arguments*, where:

- V is a set of vertices (nodes), what in argument diagramming corresponds to *messages* (formulas that are premises or conclusions),
- E is a set of arrows (directed edges) which are 2-element ordered pairs of V, what in argument diagramming corresponds to the relation of *support* (not the relation of attack).

For a digraph, two maps are defined init: $E \to V$, and ter: $E \to V$, which assign to every edge e an *initial vertex* init(e) and a *terminal vertex* ter(e). If (init(e), ter(e)) $= (x, y)$, then we will write $e = xy$.

In the standard approach there is one type of vertices in a digraph. A digraph for the model of persuasive argumentation needs to represent two types of vertices representing CR-arguments (in a diagram marked with a solid line) and PR-arguments (marked with a dotted line). The CR-arguments are central arguments that are content-based and involves issue-relevant thinking, while the PR-arguments are peripheral arguments that includes means such as credibility or attractiveness of communicator, expert opinion, testimony, popular opinion or audience's emotions. Thus, we distinguish two types of vertices $V(D)$ by defining the mapping that allows to color them with two colors CR and PR corresponding to two types of routes, i.e. central and peripheral:

Let D be a digraph (V, E). A *vertex coloring* for the model of persuasive argumentation is a map $c : V \to \{CR, PR\}$.

In tools that uses the method of argument visualization (such as e.g. Araucaria), there may be a need to diagram not only the whole argumentative text, but also these of its parts which uses the peripheral route. For example, if we analyze and visually represent a message, we may want to have a general view where in this message PR-arguments were involved. It is especially important, when the analyst want to find those parts of the message which are potentially susceptible to manipulation. As a result, it can support the skills of identifying and evaluating the elements related to the peripheral route to persuasion.

The simplest way to "extract" PR-arguments is to subtract the set of vertices colored with CR from the set of all vertices. We will call it a maximal separation and a PR-digraph obtained, written D_{PR}^{max}, will represent only those arguments which are peripheral. The CR-digraph for maximal separation can be obtained in a similar manner.

Let $D = (V, E)$ be a network of persuasive arguments. *Peripheral* directed subgraph for *maximal separation* $D_{PR}^{max} \subseteq D$ is a pair $(V_{PR}^{max}, E_{PR}^{max})$ such that:

- $V_{PR}^{max} = \{x \in V |\ c(x) = PR\}$
- $E_{PR}^{max} = \{xy \in E |\ x \in V_{PR}^{max} \wedge y \in V_{PR}^{max}\}$

Consider an example given in Fig. 1. Say that a case 1.1 shows a network of persuasive arguments D. Then, a case 1.2 represents the result of maximal separation. The set V_{PR}^{max} consists of the vertices from V which are colored with PR, i.e. b, d and e. The edges E_{PR}^{max}, that remained after maximal subtraction, have to start and end in peripherally colored vertices, i.e. ed.

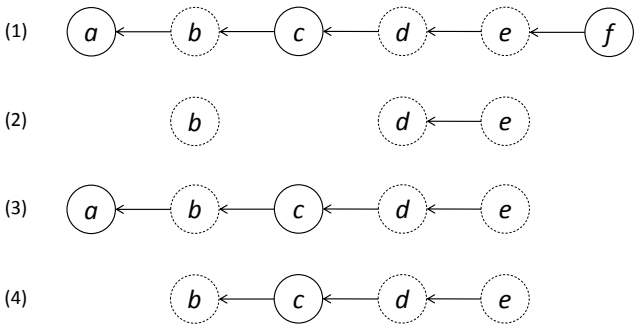

Figure 1. An example of a digraph for persuasive argumentation (1), and separation between CR- and PR-arguments: (2) maximal, (3) partial, and (4) minimal

Such an operation allows to "quickly" separate those fragments of a text that uses the peripheral route from those based on the central route. This could be useful in some applications. However, it may also be not easy to analyze a diagram obtained. In more complex diagrams, the visual representation may become "inconsistent" or "discontinuous", what can make it difficult to see the general picture of interrelation among the particular fragments of the text (compare Fig. 1.2 with 1.1). Perhaps, the more useful would be to "remove" those CR-arguments which do not "disconnect" a network of persuasive arguments. We will call it a partial separation and a PR-digraph, written D_{PR}^{part}, is obtained by subtracting those CR-arguments which are not supported by any peripheral arguments. In this manner, the "continuity" of a diagram is prevented and a main conclusion remains at the diagram even if it is central (see Fig. 1.3). The CR-digraph for partial separation can be obtained in a similar manner.

Let $D = (V, E)$ be a network of persuasive arguments. *Peripheral* directed subgraph for *partial separation* $D_{PR}^{part} \subseteq D$ is a pair

$(V_{PR}^{part}, E_{PR}^{part})$ such that:

- $V_{PR}^{part} = \{x \in V |\ c(x) = PR \ \vee \ (c(x) = CR \wedge \exists x_1 ... x_n x \subseteq D(c(x_i) = PR \text{ for } i \in \{1, \ldots, n\}))\}$
- $E_{PR}^{part} = \{xy \in E |\ x \in V_{PR}^{part} \wedge y \in V_{PR}^{part}\}$

The set V_{PR}^{part} contains those elements of V, which are: either peripheral (e.g. the vertices b, d, e in Fig. 1.3), or central (e.g. a in the case 1.3) but there need to be a path in D ending at this central element (e.g. the path $edcba$) such that one of path's element is peripheral (e.g. b). The set E_{PR}^{part}, that remained after partial subtraction, has to start and end in vertices belonging to V_{PR}^{part}, e.g. cb or ba.

We may also want to have "continuous" subgraph which not only does not start, but also does not end in the CR-arguments. We will call it a minimal separation and a PR-digraph, written D_{PR}^{min}, is obtained by subtracting those CR-arguments which are not supported by any PR-arguments or not supporting any PR-arguments. In this manner, the "continuity" of a diagram is prevented, however, a main conclusion may be removed from the diagram, if it is central. The CR-digraph for minimal separation can be obtained in a similar manner.

Let $D = (V, E)$ be a network of persuasive arguments. Peripheral directed subgraph for *minimal separation* $D_{PR}^{min} \subseteq D$ is a pair $(V_{PR}^{min}, E_{PR}^{min})$ such that:

- $V_{PR}^{min} = \{x \in V |\ c(x) = PR \ \vee \ (c(x) = CR \wedge \exists x_1 x_2 ... x_m x x_{m+1} ... x_n \subseteq D \ (c(x_i) = PR \text{ for } i \in \{1, \ldots, m\} \wedge c(x_j) = PR \text{ for } j \in \{m+1, \ldots, n\}))\}$
- $E_{PR}^{min} = \{xy \in E |\ x \in V_{PR}^{min} \wedge y \in V_{PR}^{min}\}$

The set V_{PR}^{min} contains those elements of V, which are: either peripheral (e.g. b, d, e in Fig. 1.4), or central (e.g. c in the case 1.4), but there need to be a path in D (e.g. the path dcb) such that this central element has to follow a PR-argument (in this case, the element d) and has to be followed by a PR-argument (in this case, the element b). Observe that a is removed from a diagram D, since no peripheral argument follows a. The set E_{PR}^{min}, that remained after minimal subtraction, have to start and end in vertices belonging to V_{PR}^{min}, e.g. cb, but not ba (since $a \notin V_{PR}^{min}$).

3 SPECIFICATION IN THE AIF

The Argument Interchange Format, AIF (see e.g. [4]), is an attempt to bring together a wide variety of argumentation technologies so that they can work together. At the most abstract layer, the AIF provides an ontology of concepts which can be used to represent argument structure. In the upper ontology, the argument is described by two kinds of nodes: (1) information (I-) nodes, which refer to data, and (2) scheme (S-) nodes, which refer to the passage between information nodes. The S-nodes are classified into three groups: (2.1) rule application (RA-) nodes which correspond to inference or support, (2.2) conflict application (CA-) nodes which correspond to conflict or refutation, and (2.3) preference application (PA-) nodes which correspond to value judgments or preference orderings.

At a more concrete layer, the AIF provides a set of specific argumentation schemes, i.e. forms of argument or patterns of reasoning. They can have a deductive, inductive or presumptive form. If an argument is presumptive and its premises are true, then the conclusion may presumably be taken to be true [16]. In the form ontology, argumentation schemes (such as argument from expert opinion or argument from consequences) are defined as types of RA-nodes with a conclusion description (such as "A may plausibly be taken to be true") and one or more premise descriptions (such as "E is an expert in domain D").

In order to represent persuasive argumentation in the AIF, we could distinguish two types of I-nodes corresponding to the central and peripheral routes. However, since the AIF allows to represent argumentation schemes, we may model persuasive arguments with the use of two types of RA-nodes:

- RA^{CR}-nodes representing the patterns of reasoning which involves a thoughtful considerations of arguments' content, and
- RA^{PR}-nodes representing the cognitive processes which are based on shortcuts such as communicator's credibility.

Consider two arguments: "We should lower taxes, since it will make people happy", and "We should lower taxes, since Mary said so". The first one (an instance of argument from consequences) is central, since to accept a conclusion "We should lower taxes" the receiver needs to consider the content of a premise "It will make people happy". Thus, in the AIF it is represented by the RA^{CR}-nodes (see Fig. 2). The second one is PR-argument, since in the absence of other arguments for lowering taxes the receiver has to rely on Mary's credibility. Thus, in the AIF it is represented by the RA^{PR}-nodes (Fig. 2). In this way, it is possible to query, e.g. ArgDB, not only for arguments supporting war in Iraq, but also for the PR-arguments for war in Iraq, i.e. arguments which are potentially used with an intention of manipulating the public opinion.

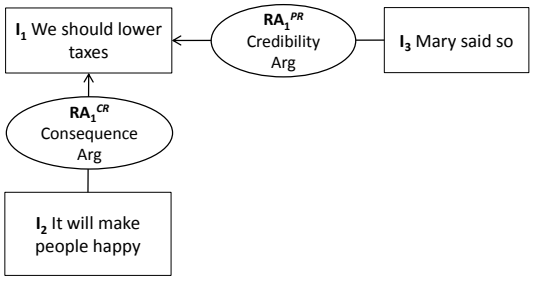

Figure 2. An example of CR-argument and PR-argument represented in the AIF

The set of RA^{PR}-nodes should include schemes of source indicators reasoning (see e.g. [22]) or ethotic [2] and pathotic arguments [3]. The ELM suggests that in the peripheral route the receivers rely on the source credibility, attractiveness or likeability. Thus, the following RA^{PR}-type schemes could be formulated:

x says α, x is credible, therefore (plausibly) α,

x says α, x is attractive, therefore (plausibly) α,

x says α, I like x, therefore (plausibly) α.

In the future work, I plan to elaborate the set of PR-schemes in a more systematic manner.

In computational approaches, the most influential taxonomy of argumentation schemes is a model proposed by Walton [23]. In this model, CR- and PR-argumentation schemes can be distinguished.

Among the Walton's set of schemes available in Araucaria, the following RA^{CR}-type schemes can be identified: argument from sign, argument from example, argument from verbal classification, argument from evidence to a hypothesis, argument from falsification of a hypothesis, argument from correlation to cause, argument from cause and effect, argument from consequences, argument from analogy, argument from waste, argument from established rule, argument from exceptional case, argument from precedent, argument from gradualism, slippery slope arguments, argument from vagueness of verbal classification, argument from arbitrariness of verbal classification and arguments from ignorance. In Araucaria, there are also the RA^{PR}-type schemes in Walton's set: argument from position to know, appeal to expert opinion, argument from popular opinion, argument from popular practice, ethotic argument, argument from bias and argument against the person.

It may seem that argument from expert opinion is a good quality argument that should belong to the RA^{CR}-type of arguments. Even though it may be used this way, it has also a potential to be used in a manipulatory manner: "[arguments from expert opinion] can be deceptive and misleading - they are sometimes powerfully persuasive even when they turn out to be groundless and flawed" [21, p.30].

The PR-arguments may be "rationalized" or "strengthen", if we testify them with the use of critical question. Thus, even if the proponent performs a "weak" argument from expert opinion trying to use its peripheral potential (based on the social mechanism of authority [5]), then the receiver may check its quality by asking critical questions associated with this type of arguments. On the other hand, if the receiver elaborates the message in the peripheral route (since an issue is not involving or there is some distraction present), then even a "weak" appeal to expert opinion may be successful. The problem of the type of route activated in a particular communicative situation is inexpressible in the pure AIF, since it does not allow to represent the context of argument performance. Partly, it can be expressed in the AIF^{+} [18], if the argument was performed in the dialogue, but perhaps its more satisfactory representation will be available in AIF2.0.

4 PROPERTIES OF CR- AND PR-ARGUMENTS

According to the ELM, in the peripheral route the receiver accepts a claim not on the basis of cognitively expensive reasoning, but on the basis of some shortcuts (such as credibility or attractiveness of communicator). That is, the PR-arguments are used by the receiver to decide whether to believe the claim "without engaging in any extensive cognitive work relevant to the issue under consideration" [9, p. 256]. Those arguments do not activate mechanisms of processing and comparing message's contents, but mechanisms of social influence (such as e.g. the mechanisms of authority or liking [5]) which are based on people's built-in (automatic) reactions.

In other words, the arguments that are effective in this type of route requires execution of different cognitive processes. In the central route, a receiver processes not only contents of arguments and a claim, but also the relation between them. In case of a message "We should lower taxes, since it will make people happy", a receiver processes the content of both reasoning's components as well as their relevance. If a hearer received a message such as "We should lower taxes, since 2+2=4", he would reject this piece of reasoning at once, not because of the false argument, but because there is no relation (relevance) between the argument and the claim.

In the peripheral route, a hearer does not (or at least "is not intended to") process this relation. As mentioned above, he does not have to engage in an extensive cognitive work *relevant* to the issue under consideration. It could be understood in this way that a hearer uses peripheral argument as a cue to believe a claim, but not necessary has to think if and what they have in common. In case of a message: "We should lower taxes, since Mary said so", Mary's credibility is used as a shortcut for believing that we should lower taxes. Observe that when the grounds for trusting Mary's words is her credibility, then the hearer does not have to, but still may consider the relation between her credibility and the issue of lowering taxes (i.e. if she is credible in the domain of taxes). However, when the grounds for trusting Mary's words is her attractiveness, then, clearly, there is no relation which could be extensively, thoughtfully considered and testified with the use of critical questions.

Generally, the arguments have different properties when executed in the different routes such as: they are activated in the different circumstances (involvement vs. lack of involvement, etc.), they are executed in the different way (higher vs. lower cognitive cost, etc.), they have different outcomes (more vs. less resistant to counterarguments, etc.), and finally - they have different structure basis (content-based vs. heuristic-based).

5 CONCLUSIONS AND FUTURE WORK

In legal argumentation, the most important function of message is the interaction among arguments. Thus, analysis of this type of communication may concentrate on how reasons support e.g. a judge's decision. However, when we are interested more about the communication typical for politics or advertisement, we can discover that substantial (content-based) arguments play the secondary role, and the majority of the message is supposed to influence the receiver with the use of different means. For example, when a beautiful girl stands by a car and the advertisement says "Prices start from 8.000 pounds", the advertiser hopes that the presence of the attractive girl will influence potential buyers. Otherwise, he would use only the CR-argument referring to the good price of his product.

The paper proposes the basic formal framework of the persuasive arguments inspired by the elaboration likelihood model (ELM). ELM suggests that there are two different types of routes to persuasion and two different types of persuasive arguments: central and peripheral. Three directions of future research are particularly attractive. First, I plan to consider a taxonomy of peripheral schemes of argumentation. Next, other theories of persuasion as well as formal rhetoric should be explored and compared with the account of persuasive function of communication proposed by ELM. Finally, the relation of attack in the network of persuasive argumentation should be examined. One way to accomplish it would be to assume that in case of a CR-argument attacking a PR-argument the CR-argument wins because of its "quality". However, the ELM could be also interpreted in this way that depending on the route activated we need different semantics to compute the result of an attack. For example we could assume that a CR-argument will win in the central route and lose in the peripheral route.

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