Conceptual analysis of an argumentation: using argumentation schemes and the Toulmin model

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This investigation explores the correlations that exist between argumentation schemes and the Toulmin model, and how these can be used conjointly to develop a more accurate conceptual representation of an argumentation structure. It is based on a natural language corpus of claims and attacks or supports developed in the social domain. Claims and justifications are annotated using a system of XML-based frames focusing on linguistic and conceptual features.

KEYWORDS: argumentation schemes, comparison, Toulmin model, warrant

1. INTRODUCTION AND CHALLENGES

In this contribution, we explore the relations and the potential cooperation between the Toulmin model on the one hand and the model of argumentation schemes on the other hand. The goal is to deepen our understanding of the interactions between these two models and to develop a more accurate semantic representation of arguments in context.

The investigation which is reported in this paper is based on the elaboration of schemes from Warrants/Backings as given in (Walton et ali. 2012), (Walton 2015) via (Eemeren et al. 1996). These authors have shown the general defeasible character of the reasoning that is involved in schemes.

With respect to these two approaches, our goal is to:

- investigate precise forms of cooperation between the Toulmin system and argument schemes to have a precise and concrete analysis of the validity of an argument in context;

- consider corpora and work on selected case studies as a preliminary analysis level to validate our analysis;
- suggest elements of a formal model that develops the cooperation of the two models with related logical devices.

In this article, we first offer a reminder of the main aspects of the two models considered, the Toulmin model and argumentation schemes, then we introduce the corpus of authentic texts used for this exploratory study, from which three case studies are extracted and analyzed in the following sections. The last sections of this paper focus on offering a formal representation of the possible integration of warrants and argument schemes, and an exploration of the use of warrants to answer critical questions.

2. OVERVIEW OF THE TWO PARADIGMS

2.1 The Toulmin Model

The goal of this model is to organize the structure of an argument. Following is a representation of a typical argument cell as described in the Toulmin model (Toulmin 1958), (Toulmin 2001) (Freeman 2005a):

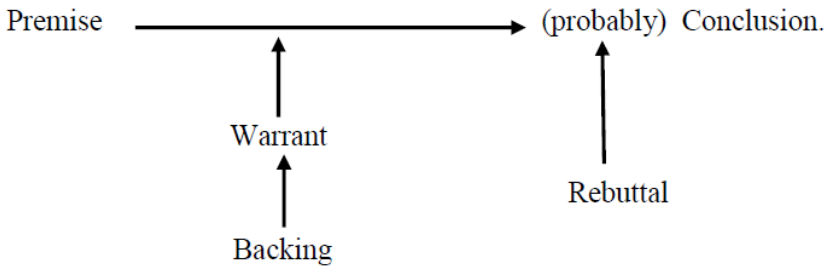

Figure 1 –Toulmin's model (Toulmin, 1958)

This representation can be illustrated with the following example:

- **Premise**: Temperatures are below 0°C this morning.
- **Conclusion**: The garden will suffer.
- **Warrant**: Plants in general are damaged by temperatures below 0°C.
- **Backing**: It is a physical law in botanic.
- **Rebuttal**: Unless they got early sun or were well protected, etc.

The different elements of the model can be defined as follows:

- **Conclusion** (also called "claim"): the conclusion being drawn from the premise(s);
- **Premises** (which can be called Grounds/Facts/Evidence): the data and facts offered to support the claim (not represented above);
- **Warrant**: the element that logically connects the grounds to the conclusion;
- **Backing**: the element that supports or explains the warrant. While the warrant may be a precise and contextual element, the backing is usually a general fact, such as the physical law in the example above;
- **Qualifiers**: statements about the strength of various elements, to be understood in context (not represented above);
- **Rebuttal**: exceptions to the claim.

Some versions of this model include additional, more peripheral, structures which will not be considered here.

2.2 The role of argument schemes

Argument schemes are specific modes of arguing which are not logical forms of reasoning and occur in everyday arguments. Several classes of argument schemes have been identified, covering most argumentative situations. For example, one of the most common argument schemes is "Argument from expert opinion" (Walton et ali. 2008), which states that:

Major premise: Source *E* is an expert in subject domain *S* containing proposition *A*.

Minor premise: E asserts that proposition *A* is true (false).

Conclusion: A is true (false).

One of the specificities of argument schemes is the inclusion of critical questions that enable the conclusion of the argumentation to be questioned by a respondent, and can serve to sound the quality of an argument. For the argument scheme introduced above, one of the critical questions is: *Is* A *consistent with what other experts assert?* If it is not the case, doubts on *E*'s judgement on the veracity of proposition *A* may arise, as well as doubts on the credibility of *E*.

Given an argument, one of the main difficulties is to evaluate the underlying (defeasible) reasoning mechanisms at stake, their scope and validity. It is in general quite challenging to identify the argument scheme(s) that are used in a specific argument, linking premises to conclusions. Our aim is to identify schemes from mined resources, then, to evaluate the scope, the strength and the validity of schemes in precise contexts, We then attempt to offer complements to the schemes by

identifying the role the system of warrants and backings described by the Toulmin model of argument could play in a given argument scheme. Our objective is to investigate how these two frameworks might cooperate to produce a more accurate analysis of the validity of an argument in context.

Our experimental protocol is as follows:

- consider a claim or an argument;
- use our argument mining tools to extract supports, attacks and warrants from these corpora (Saint-Dizier 2018), as well as induce warrants if possible. These tools are based on grammatical clues and are implemented on our TextCoop platform. Other systems include for example (Nguyen and Litman, 2015);
- manually identify a scheme or a family of schemes which can be candidates, show how the variables of the schemes get instantiated via warrants, following, in particular (Garcia et ali. 2007);
- provide some evaluation of the validity of a scheme in context;
- consider the critical questions associated with the argument schemes identified and show how these can be (partly) answered.

3. CONSTRUCTION OF A CORPUS

The first step of our work is to construct a valid corpus from which case studies are taken. For that purpose, we consider six topics related to different domains linked to social issues. The corpus is constructed from a "seed" which is a controversial statement. This technique is also known as bootstrapping. This seed is submitted to the web, from which statements that support or attack it are then extracted. Duplicates are frequent and are eliminated to prevent the overrepresentation of some statements.

The seeds considered for our experiment are the following:

(1) Ebola vaccination is necessary,
(2) Women's conditions have improved in India,
(3) The development of nuclear plants is necessary,
(4) Brexit is good for the UK,
(5a) Affirmative Action is good for the economy,
(5b) Gender parity is reachable.

Table 1 presents the size of the text extracts integrated into the corpus; the texts considered are those which contain a support or an attack, including the context for the controversial statement at stake. The last

column indicates the rough number of arguments identified, given that arguments often present themselves in clusters and are notoriously difficult to separate and count. It is interesting to note that the number of arguments is not large. Indeed this means that the linguistic resources and knowledge resources needed for a certain topic may not be so large, and therefore their development and implementation possibly from already existing resources may be possible.

Topic	Corpus size	Nb. of arguments identified
(1)	16 extracts, 8300 words	50
(2)	10 extracts, 4800 words	27
(3)	7 extracts, 5800 words	31
(4)	23 extracts, 6200 words	22
(5)	5 extracts, 2200 words	26
Total	59 extracts, 27300 words	156

Table 1. Presentation of the exploration corpus

From this corpus, we consider several case studies of different degrees of complexity. They are presented and analysed in the next section.

4. ANALYSIS OF CASE STUDIES

Let us consider in this section three case studies taken from different domains.

4.1 Case 1: Argument scheme based on practical inference

Let us consider the following argument, where the seed is the first part of the statement. It is followed by a justification which may be supported or attacked:

Brexit is a good step forward because citizens want a healthy economy.

This argument is based on several supports, attacks or warrants extracted or induced from our corpora via a grammar dedicated to argument analysis implemented on our TextCoop platform. Let us consider here two of these warrants:

W1: Citizens want to live in optimal conditions,

W'1: Isolating a country is the best way to get a healthy economy.

We analyse this argument as being an argument cluster, part of which can be interpreted as fitting the scheme "Practical inference" (Walton et al., 2008, p. 323).

Practical inference (subset of Practical reasoning, slightly adapted):

Major premise: A group of people have a goal *G*.

Minor premise: Carrying this action *A* is a means to realize *G*.

Conclusion: Therefore, they ought (practically speaking) to carry out this action *A*.

Let us note that this conclusion is not expressed in the claim above, but constitutes an intermediary conclusion leading to the identification of action *A* as positive, possibly through the scheme "Argumentation from ends and means" (Perelman and Olbrechts-Tyteca, 1969, p. 273-278, via Walton et al., 2008, p. 325).

Then, merging schemes and the Toulmin model can be expressed as follows:

- a general version of *G* is expressed in W1,
- a general version of *A* is expressed in W'1 (note that there are several actions A_i which can have the same effect).

Then, given these elements, if G = W1 and A = W'1, and the action is considered generally positive in virtue of allowing an end to be reached, then follows:

Brexit is a good step forward.

This example shows that argument schemes are more generic than the Toulmin model, in a certain sense, since the parameter values extracted from the linguistic data which instantiates the Toulmin model, can, in a next stage, instantiate the variables in the argument scheme considered. The analysis of these values and their relevance with respect to the scheme allows to evaluate how relevant and valid the selected scheme is. Then a certain semantic representation of the argument can be developed.

4.2 Case 2: Going deeper into the scheme: deliberation based on several warrants

In this section, we illustrate how linguistic material collected via argument mining, within the framework of the Toulmin model, can be reused to motivate or help determine which argument scheme is the most appropriate. The complexity of this problem is developed in (Kock 2003). Let us consider now the following argument:

> Vaccination against Ebola is necessary because it prevents disease dissemination.

Let's assume a deliberation based on several factors Di, with supports or attacks collected from an argument mining process, such as the following examples:

Examples of supports:

- Vaccine protection is very good;
- Ebola is a dangerous disease;
- There are high contamination risks, etc.

Examples of attacks:

- There is a limited number of cases and deaths compared to other diseases;
- Seven vaccinated people died in Monrovia;
- Vaccine may have dangerous side-effects, etc.

It is possible to induce some warrants from the supports and attacks extracted using our method. For example, the following warrants could be induced by our system:
W2: it is necessary to protect a population against major diseases.
W'2 it is important to care about side effects of medicines.

Then, the deliberation being illustrated in this section consists in comparing and weighing the different warrants which were induced from the attacks and supports taken from the corpus.

It is also possible, from the examples above, to manually elaborate a synthetic warrant W"2 such as the one introduced below. This could be viewed as reconstructing an enthymeme (Jackson et al. 1980). It would summarize the deliberation and give its argumentative direction or polarity, which is useful for the scheme to be validated:

W''2: (generalization) it is important to have good management of medical situations to make good decisions, for example regarding possible side effects, incurred costs, in order to effectively protect a population.

Then, the scheme that is the most appropriate depends on (1) the propositional content but also on (2) the sources of attacks or supports, in particular whether they come from simple bloggers or political commentators, expert reports, the general population, etc. For example a source identified as coming from experts would trigger a scheme related to expertise.

In the case of our example, the source is identified has not being from an expert. Given these considerations, a potential argument scheme could be "Argument from deliberation *Ad Populum*", assuming there has been a deliberation of a sample of a standard population (in contrast with a group of experts, as mentioned above):

Argument scheme from deliberation *Ad Populum*:

> *Premise 1:* Everybody in group G accepts A.
> *Premise 2:* Group G has deliberated intelligently and extensively on whether to accept proposition A or not using the considerations Di.
> *Conclusion:* Therefore, A is (plausibly) true.

In this context, the variable A, which represents the opinion being deliberated, can be associated with several, possibly weighted, warrants which are instances of a rule R, a hypothesis H or a situation A.
The warrants W and the other elements of the deliberation, because of the additional content they provide, give more validity and context to the scheme being considered. In the case of a group of experts being involved in the deliberation, a slightly different argument scheme would have been proposed, namely the scheme "Argument from expert opinion".

4.3 Toward a formal account of the cooperation between argument schemes and the Toulmin model

Let us now introduce a first level of formalization of the cooperation between the two models. In this investigation, it is possible to use a compositional and monotonic approach. Let us consider in this section a few well-known schemes and the integration of elements of the Toulmin model.

For the abductive reasoning scheme, a global formal expression of the entailment proposed in this scheme can be summarized as follows:

$$\text{explanation}(E, F, C) \Rightarrow A.$$

This formula simply paraphrases the language formulation.

Let SW be the set of warrants W that are relevant to this scheme:

$SW=\{W1..., Wn\}$.

Then, the integration of explanations considered as warrants can be realized compositionally via a lambda expression which scopes over warrants W as follows:

$\lambda E\ (explanation(E, F, C) \Rightarrow A)(SW)$.

Let us now consider the argument scheme "Argument from deliberation *Ad Populum* " as illustrated in the previous section. Several elements related to the deliberation are considered in this formal model. The global formal expression is:

$\forall i \in [1, m], D=\{d_i, deliberation(G, A, D) \Rightarrow A$.

where the set of induced warrants is computed by the function: induce(D, SW).
The integration of these elements in the initial formal expression above yields:

deliberation based on induced warrants:
$\lambda D\ (deliberation(G, A, D) \Rightarrow A)\ (SW)$.

Although this first formal level is compositional and seems to capture the main intuitions behind the scheme, it lacks the weights on the Wi which are essential elements, as some warrants may have higher weight or priority than others.

4.4 Argument scheme with conflicting Warrants

Let us now consider a case where a scheme can be based on conflicting, i.e. a priori incoherent, warrants as presented in (Saint-Dizier, 2018). To illustrate this aspect, we consider a few motivational examples. From the statement:

This film is good because it is politically correct.

A number of warrants can be mined, as explained above. For example:
W3: (only) politically correct ideas are appreciated by the public,
But opposite warrants/attacks were also mined, for example:
W'3: it is good to criticize standard education via political incorrectness to promote the evolution of minds.

If, for example, we consider the scheme "Argument from popular opinion":

> *General acceptance premise:* A is generally accepted as true,
> *Presumption:* If A is generally accepted as true, this gives a reason in favor of A,
> *Conclusion:* There is a reason in favor of A.

In this scheme, if the opinion A remains valid, it is nevertheless weakened by W'3 and related elements since W'3 introduces a kind of attack. The weight of the attack is not considered here. From this example, it can be noted that the cooperation between schemes and warrants is therefore quite tricky, in particular when there is the inclusion of authentic data collected on the basis of argument mining techniques.

5. EXPLORING THE USE OF WARRANTS TO ANSWER CRITICAL QUESTIONS

The critical questions associated with argument schemes are a means to show that schemes are not logical deduction, but may be subject to contradictory evaluations. A problem that is frequently encountered is the identification of relevant critical questions. It is particularly interesting to base this search on corpora, where real case situations can be identified and weighted.

To illustrate this feature, let us consider again the "Deliberation *Ad Populum*" argument scheme, with the group of people G presented above. The critical questions proposed are, among others:
(1) how competent and representative is the group G?
(2) what are the elements considered during the deliberation?
(3) are they sufficient to allow A to be `inferred'?
Let us now consider one of the claims that we have investigated: *Vaccine protection is very good* which has been debated by the group G. Let us assume that this deliberation has originated a number of supports and attacks which constitute the d_i, which are repeated from above for an easier reading:

Example of supports:

- Ebola is a dangerous disease;
- there are high contamination risks;

Examples of attacks:

- there is a limited number of cases and deaths compared to other diseases;
- seven vaccinated people died in Monrovia;

- vaccine may have high side-effects.

Given these mined supports and attacks, our approach allows to go deeper and in a more concrete way in the debate represented in the argument scheme. In particular, our approach allows to answer critical question (2) above via the d_i defined above, possibly weighted.

Then critical question (3) can be partially answered via the induction of SW (section 4.3) where its scope and generality can be analyzed. Finally, critical question (1) is more delicate to answer, however the scope and quality of the d_i (relevant, insightful, etc.) can contribute to answer this question.

6. RESULTS AND EPILOGUE

In this article, we have investigated precise forms of cooperation between the Toulmin model and argument schemes with the goal of being able to offer a precise and concrete analysis of the validity of an argument in context, using argument mining tools. The analysis presented in this article is clearly preliminary and exploratory. It is based on a few test cases taken from real life situations, with all their complexity and contextual effects. In spite of its exploratory character, we feel that our analysis raises interesting questions and some elements of solutions.

This analysis needs to be extended in at least the following directions:

a larger corpus needs to be compiled and also analyzed, possibly with a higher diversity of sources, or on the contrary with a focus on a specific type of source in order to streamline the type of claims and argument schemes found,

the impact of context in general and on the validity of argument schemes needs to be more thoroughly investigated,

the related aspects of argument mining need to be developed in order to be able to access to a large amount of relatively reliable data.

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