

# Evaluating the Strength of Arguments on the Basis of a Linguistic Analysis: A Synthesis

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**Abstract.** In this contribution, we present several layers of linguistic analysis, the aim of which is to provide indications on the strength of arguments in context. This contribution proposes a synthesis of existing resources to evaluate strength also used in opinion analysis, then it develops features which are proper to argument strength. Linguistic elements related to (1) the argument contents, (2) the discourse structures associated with this argument (which may introduce restrictions), (3) the nature of argument schemes used, and (4) some rhetoric elements are investigated.

## 1 INTRODUCTION

There are several ways to measure the strength of arguments. The strength can be measured from a logical and pragmatic perspective or it can be measured from a language point of view. Both approaches are not necessarily coherent but they must be combined to produce a relatively accurate measure of strength. Argument strength may be measured for each argument in isolation or for groups of related arguments, taking into account their relations and structure.

In this contribution, an argument is composed of a claim and of one or more propositions  $P_i$  which support or attack the claim. Claims and propositions  $P_i$  have their own strength. In this contribution, we first identify linguistic phenomena and their related cues which are a priori marks of strength on propositions  $P_i$  taken in isolation. We then integrate this analysis into a larger view where a proposition  $P_i$  is associated with discourse structures which may reinforce or weaken its strength. In a subsequent stage, sets of related propositions  $P_i$  are considered, so that their relative strength can be characterized on the basis of linguistic factors. Finally, the impact of argument schemes and rhetoric cues is explored to give an overall picture of how argument strength based on linguistic analysis can be measured. Priority is therefore given to linguistic analysis, in which results of lexical semantics are relatively stable and accurate, over a more pragmatic and intuitive analysis of argument strength.

This investigation and analysis is carried out within the framework of argument mining and analysis in which, given a controversial issue, arguments for or against this standpoint are mined in different types of texts (see for example [11], [10]). Besides supporting or attacking an issue, propositions  $P_i$  may also attack or support each other. The problem of the relatedness between a claim and propositions  $P_i$  has been addressed in [16], it will therefore not be discussed in this contribution which focuses on a crucial and difficult parameter: evaluating the potential strength of an argument. In our perspective, persuasion is a kind of contextual evaluation of the strength of an argument. This will not be addressed here, although it is clear that it should be the ultimate component of such an investigation.

Quite a large number of investigations, more or less successful and ad hoc, have been developed within the framework of opinion analysis. This document reviews the main results and develops additional or more specific material proper to argument strength analysis. In opinion analysis, platforms and resources such as Sentistrength (<http://sentistrength.wlv.ac.uk/>) and the Stanford Sentiment Treebank. Major synthesis on opinion strength are developed in [17] and [8]. However, if some features are shared with argument strength analysis, argument strength is more complex to characterize since an argument is a complex system composed of a claim, one or more justifications, and quite frequently some forms of evidence, backing and warrant and rebuttals. Qualifiers may also be stated. Finally, the nature of the argument scheme that has been used may be crucial. This contribution develops a synthesis of a number of these aspects.

Investigations on argument strength have focused on a few aspects such as (1) teaching how to organize written essays and how to organize arguments and give them an appropriate strength, (2) research on persuasion which is, in our view, an analysis of strength in contexts (domain and listeners are taken into account), and (3) in theoretical analysis of argumentation where graphs of attacks and supports are developed. Let us note for example [6] that deals with an in-depth analysis of persuasion, [23] which investigates the content of persuasive messages. Sensitivity to argument strength of various populations is developed in e.g. [3].

The relation of strength with rhetorical questions has been addressed in e.g. [12]. A number of linguistic factors are analyzed in e.g. [1], and later in [18], [19]. However, to the best of our knowledge little has been done to characterize argument strength from a linguistic point of view, within the perspective of argument mining. This article is a contribution to this perspective, it also outlines the high context sensitivity of linguistic factors.

This paper is organized as follows. In a first stage, the contribution to argument strength of individual lexical items found in propositions  $P_i$  is investigated. The hypothesis is that such propositions have an intrinsic strength independently of the claim. Lexical semantics structures to organize linguistic data are introduced. Then, the strength variations induced by the combination of several lexical items in a proposition and the support construction in which it may be embedded are explored and tested experimentally. Since it turns out that contextual effect in its broad sense is crucial to have an accurate estimate of the strength of an argument, several contextual parameters are discussed, in particular the impact of the discourse structures which are adjoined to the argument or to a proposition  $P_i$  and the kind of argument scheme on which the argument relies.

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## 2 THE ANALYSIS CORPUS

Several types of corpora are used to carry out this investigation. Documents are oral or written, they are essentially in English with a few of them in French. Our corpus is composed of the following elements:

- a corpus of debates extracted from the BBC Moral Maze, analyzed in conjunction with the university of Dundee, with about 2000 arguments [2], available on their platform,
- a corpus of consumer opinions in the hotel domain [20] and in relation with the services offered by the local French airline HOP! (French texts); this corpus is particularly rich in discourse structures which modify argument strength and scope, which includes about 250 arguments,
- a corpus of short texts, that contains about 150 arguments, used to identify the relatedness problem [15], [16] from the domains of vaccination, nuclear energy (in French), and women's condition in India.

These corpora are quite diverse in nature and linguistic characteristics, they allow an accurate identification of the linguistic elements at stake in the expression of strength. This corpus is used to identify and evaluate the importance of various linguistic constructions and linguistic resources in strength expression, it is therefore difficult to evaluate its relevance a priori. The main point is that it contains a large diversity of types of statements so that most linguistic phenomena can be observed, but probably not quantified, which is not our aim at this stage.

## 3 STRENGTH FACTORS WITHIN A PROPOSITION

Given a claim, propositions  $P_i$  for or against it are essentially evaluative statements. These may be direct evaluations or may require knowledge and inference to identify what is evaluated and how. The terms used in propositions  $P_i$  to provide an evaluation of a standpoint induce a polarity for the argument and strength indicators which say whether their attack or support is strong or weak. This section explores the linguistic phenomena and their related cues, within the propositions  $P_i$ , which may potentially be strength indicators. The hypothesis is that such propositions have an intrinsic strength independently of the claim, which is explored in this contribution. It is however clear that the strength of the argument is a combination of the strength of the claim and of the proposition that supports or attacks it.

Evaluating the strength entailed by linguistic cues is quite subjective. Our goal is to collect those marks and to structure them according to scales. Evaluating their real impact in context requires measures which go beyond this analysis, but this is a necessary step. Some simple elements are given in section 3.4. Each linguistic cue is investigated in isolation, then the correlation of several cues is investigated.

Two levels of the expression of strength are considered here: (1) the implicit strength conveyed by head terms used in propositions and (2) the strength conveyed by expressions, such as propositional attitudes expressions, of which a proposition  $P_i$  is the sentential complement. The propositions  $P_i$  considered in this investigation have a simple syntactic structure. They are composed of a main point called the kernel and adjuncts – in general discourse structures – which add e.g. restrictions, justifications, purposes or illustrations to the kernel.

These discourse structures may scope either over the proposition or over the entire argument.

The linguistic resources which are used are those of our TextCoop platform, with which discourse analysis and argument mining is realized. Resources considered in this investigation come for a large part from general purpose and domain dependent lexical resources we developed for opinion analysis.

### 3.1 A categorization of the expression of strength

As also shown in the area of opinion analysis, there are many elements which may have an impact on the strength of a proposition  $P_i$ . Those with a higher impact are head elements such as verbs, and elements which are less prominent in the syntax such as evaluative adjectives and adverbs. These latter are analyzed as adjuncts to the noun for adjectives and to the VP or the sentence for adverbs. These linguistic elements are used to determine the orientation of the propositions  $P_i$  w.r.t. the claim (support, neutral, attack). In addition, their implicit semantics is an important factor to evaluate the overall strength of an argument.

The main categories of elements internal to a proposition  $P_i$  which may impact the strength are:

1. positively oriented verbs, such as:  
*improve, benefit, optimize, reinforce, preserve, strengthen, guarantee, consolidate.*  
e.g. *vaccination against Ebola is necessary because it guarantees the non-proliferation of the disease.*  
There are many such verbs, the semantic function of which may vary over domains.
2. negatively oriented verbs, such as:  
*affect, alter, break, demolish, hurt, lessen, ruin, undermine, damage.* For example, given the claim:  
*the situation of women in India has improved,*  
it is attacked by the proposition:  
*the persistent lack of education largely affects their independence.*
3. similarly to verbs, a number of adjectives and adjectival compounds contribute to the orientation and strength expression. These are usually found in propositions where the verb is neutral (auxiliary, light verb, verbs such as *allow, enable*, where the orientation of the object is crucial) or is largely underspecified w.r.t. to polarity and strength. Adjectives in this category are, for example: *useful, capable, consistent, resistant, compliant, beneficial, optimal*  
for the positively oriented ones and:  
*risky, polluted, dangerous, weak, harmful*  
for the negatively oriented ones. A typical example is e.g. :  
*vaccination against Ebola is dangerous because the adjuvant is toxic*, where *toxic* induces the orientation and the strength.
4. expressions derived from verbs, past participles, and adjectival compounds with an evaluative or scalar dimension such as:  
*disappointing, potentially risky.*  
For example, a negatively oriented argument in relation with a standpoint on the necessity of nuclear plants is:  
*Pipe corrosion in nuclear plants is potentially risky.*
5. nouns which appear as NP objects in the proposition which have a positive or negative orientation, e.g.: *risk, disease, reward, success.*

The expression of strength is also mediated by a number of terms which introduce propositions  $P_i$ . These are called **control constructions**, they sub-categorize for a proposition or a sentential comple-

ment which is here a proposition  $P_i$ . These constructions, although found in opinion analysis, are more developed in argumentation. They also appear in dialog analysis in general. The scope of these constructions is the entire argument, not the justification, as it would be the case in opinion expression. Control constructions can be organized according to the following linguistic categories:

1. Propositional attitude verbs and expressions: besides the expression of agreement or disagreement, which is their main aim, most of the elements of this category have an implicit weight. In this class fall verbs and expressions such as:

*think, believe, agree, deny, argue, refute, acknowledge, reckon, disagree, accept, reject.*

The semantics of these verbs is investigated in depth in [22]. These elements have different weights which may depend on the context and personal interpretations, for example, *believe* may be weaker or stronger than *think*. Propositional attitude constructions do not have, a priori, an impact on the argument orientation. Propositional attitude constructions can be modified by a negation or by a modal such as *would, could, have to* as in: *I would argue that, I have to acknowledge that*. These may impact the strength.

2. Psychological expressions or expressions denoting a desire, a position or an experience. These expressions may be at the origin of the expression of a doubt or a weak support; they include verbs and expressions such as:

*I feel, I am worried about, I am intrigued by, dream of, be encouraged by, tend to.*

These terms are often in an initial position or in a final position for constructions such as *worries me* as in: *the obligation of vaccination worries me*, where the nominalized sentence is raised to play the role of the subject.

3. Report verbs and associated constructions. They introduce arguments and propositions  $P_i$  in a direct manner or as a reported speech from e.g. other participants in a debate or from external persons, frequently considered as experts (see also Section 4.2). Similarly to the two above categories, these constructions can be modified by a negation or a modal. In this category fall expressions such as: *report, say, mention, stated, announced, discuss, claim* and their morphological variants. Identifying the strength of these terms is difficult: while *report, say, announced* are rather neutral, terms such as *claim, stated* are much stronger. For example, given the claim:

*Ebola is a dangerous disease,*

a strong attack may be:

*the authorities of Guinea claimed that there is no risk of proliferation of Ebola.*

4. Epistemic constructions. These also occur quite frequently, they include expressions such as:

*know, my understanding is that, I am convinced that, I suppose, I realize, it is reasonable to assume, infer, implies, I can see.*

While some introduce doubts or uncertainty, others are clear affirmations of a certain knowledge that may contradict or support a standpoint.

5. Modal expressions. These behave as left adjuncts and modify some of the expressions described above or may be adjoined to the head verb of the argument. Most of them either weaken the statement or introduce forms of hypothesis:

*might, would, must, have to, could be, should be possible, it is reasonable to, can mean, may mean.*

For example, for the claim on vaccination against Ebola, a weak support could be:

*a systematic vaccination could define sanitary belts to avoid the proliferation of the disease.*

6. Adverbials related to the expression of opinion. In our corpora, they frequently increase the strength of the arguments. They include:

*probably, necessarily, most definitely, definitely, surely, usually, frequently, often, certainly, of course, obviously, generally speaking, of course, indeed.*

## 3.2 Structuring expressions of strength by semantic category

It is obviously impossible to a priori assign strength values to the terms given in the different categories given above, nor is it possible to assign weights to their combinations. A option is to structure these terms along scales [4], as for scalar adjectives in opinion analysis. In this experiment, it turns out that the polarity of about 75% of the adjectives are domain independent. While the adjectives used in opinion expression lend themselves relatively easily to an evaluation of their positive or negative character, this is more complex for verbs, modals or the expressions categorized above. To organize the elements in the different categories, an experiment is made using non-branching proportional series (Cruse 86) which allow to define partial orders over groups of terms w.r.t. a given measurable property. These scales organize terms of a category from those with a strong negative orientation to those with a strong positive orientation. A neutral point is mentioned: it is a term when such a term exists or an abstract point. The partial order introduces some flexibility by allowing several terms to be at a given point on the scale when it is not relevant to make strength distinctions between them.

Our approach is

- (1) to classify the terms of each category in a dedicated scale following their standard semantics,
- (2) to evaluate the results and to possibly revise the classification according to the results obtained from the experiment reported in 3.4.

For example, the negatively and positively oriented verbs given above (3.1, items 1 and 2) are structured as follows:

[ [ruin] - [break, demolish] - [affect, alter, lessen, undermine, damage] - [hurt] - Neutral - [preserve, guarantee] - [benefit] - [improve, consolidate, strengthen] - [optimize] ].

Terms which are considered to have almost the same strength appear in the same set, represented between square brackets. The neutral point is represented by the constant 'Neutral', the two sets around it have a moderate strength while the extremes sets are the strongest ones.

Adjectives are more difficult to structure because they do not modify in an homogeneous way the same property, for example, *resistant* and *optimal* may not operate on the same concepts, where *optimal* is rather higher-order. A global scale such as the following can however be developed:

[ [dangerous, harmful] - [risky, polluted] - [weak] - Neutral - [useful, capable, consistent, beneficial] - [resistant] - [optimal] ].

In this example, a certain number of adjectives is in the same set since these have a relatively similar impact on strength.

Finally, a scale for propositional attitude verbs is the following:

[ [deny - refute - reject] - [disagree] - Neutral - [believe, think, accept] - [agree,

acknowledge, reckon] - [argue]].

The verbs to the extreme of the scale are more crucial in the acceptance or rejection of the claim than those close to the Neutral point. Adverbials modify these verbs or the VP they head by adding or reducing the strength. These can be classified as follows by increasing strength:

[[probably] - [indeed, usually, of course]  
- [often, frequently, generally speaking] -  
[definitely, surely, obviously, necessarily]  
- [most definitely]].

### 3.3 Strength representation when combining categories: a basic model

It is frequent to have propositions  $P_i$  that include terms from the two levels presented in section 3.1: a first level of strength is expressed within the proposition and then the proposition is embedded into a variety of constructions from the second set of categories. For example, given the claim:

*Nuclear plants are useful since they pollute less than coal or oil.*  
a proposition such as:

*I am definitely convinced that nuclear plants should be banished.*  
includes the strong negative term *banished* in its statement, which is somewhat softened by the modal *should*. This proposition is included into an epistemic construction with a strong connotation: a strong verb *convinced* modified by the intensifier adverbial *definitely*. Evaluating the strength of such a proposition compared to e.g.:

*I am convinced that nuclear plants must be banished.*  
is not trivial, even for human experts.

To have an accurate analysis of the strength of propositions  $P_i$ , a semantic representation of the elements which contribute to strength expression is developed. It is based on the categories of the elements found in the proposition and on a rough estimate of their strength, as reflected by the non-branching proportional series presented in section 3.2. For example, the proposition:

*Nuclear plants should be banished.*

has the following semantic representation w.r.t. its strength:

[*argument* verb(strong negative)  $\wedge$  modal(weaken)].

where *banished* is among the strongest negative verbs on the corresponding scale while the modal *should* weakens the strength of this verb. Then, the whole proposition:

*I am definitely convinced that nuclear plants should be banished,*  
which includes an epistemic construction, is represented as follows:  
[*control* verb(epistemic, strong positive)  $\wedge$   
adverbial(reinforce)]([*argument* verb(strong negative)  $\wedge$   
modal(weaken)]).

Let us call this expression the **signature of the strength of the proposition**. Considering the different elements of this representation, the resulting strength is strong with a negative orientation.

A simple way to identify the strength of an proposition is to develop composition equations:

- in the proposition: the head terms are the verbs or the adjectives. They a priori have a polarity and a strength level which is lexically induced. A standard scale with 5 values: [null, weak, average, high, maximal] is used in this first experiment. These lexical structures may be combined with intensifiers which are modals for verbs and adverbs for adjectives. Intensifiers weaken or reinforce the strength of the element they modify. For example, if *banished* has the strength 'high' with a negative orientation, then *should* lower it to 'average' while preserving its orientation.

- The same strategy holds for the structure in which the proposition is embedded. For example, *I am definitely convinced* is composed of a head verb with strength 'high', and the adverbial *definitely* increases its strength to 'maximal'.
- The strength and orientation of a proposition are combined with the control structure in which it is embedded. The resulting strength is a function of the strength of each structure, for example the average. In our example, 'maximal' must be combined with 'average', leading to 'high'.

This model takes into account the different linguistic parameters of an proposition, it is however very simple: it is based only on linguistic considerations and on an a priori strength evaluation of each lexical element. It does not take into account other crucial factors such as the context of the utterance, the argument schemes used, the domain and its style, the intonation and the preceding claims and propositions  $P_i$ .

### 3.4 An experimental evaluation of strength based on annotations

It is difficult to ask annotators to evaluate the strength of propositions  $P_i$  without any analytical support. The model provided in the previous section, although quite simple, can be used as a support for annotators who can concentrate on each element separately and then make a global evaluation of the strength. In this section, a new protocol for strength analysis is introduced.

The idea is to automatically annotate propositions  $P_i$  with the values described in 3.3, and then to ask human annotators to indicate their own evaluation for (1) a proposition, (2) the embedding structure when it exists, and (3) the combination of the two. In a subsequent stage, discourse structures will also be annotated using our TextCoop platform. The manual annotations can then be compared to the annotations produced by the system as described in section 3.3. A more accurate model of strength analysis can then be developed from these two evaluations.

Let us now illustrate the annotation structure that the annotator uses. The annotator must specify the strength and possibly the orientation for each of the uninstantiated attributes (strength, orientation, intensity). The above example is annotated by the system, based on a lexical and surface syntactic analysis; values are left open so that annotators can filled them in:

```
<proposition strength= , orientation = >  
<support strength= , orientation = >  
I am definitely convinced that </support>  
<kernel strength= , orientation = >  
nuclear plants  
<modal intensity = > should </modal>  
<verb strength= , orientation = > be banished  
</verb> </kernel> </proposition>  
with strength  $\in$  [null, weak, average, high, maximal]  
orientation  $\in$  [positive, neutral, negative]  
intensity  $\in$  [lower, increase].
```

A first, preliminary experiment aims at identifying the strength differences as postulated a priori by the linguistic description and as perceived by humans. Contextual effects, such as the style or the strength of other arguments, are not taken into account in this first experiment in order to concentrate on propositions and arguments strength taken in isolation. The contextual dimension will be considered in a second stage (see section 3).

In this initial experiment, a set of two hundred propositions have been annotated. These are constructed via lexical variation, to ac-

curately evaluate the impact of each lexical item, from 15 original claims. In these propositions, the lexical items which originate the strength are substituted by others, e.g. *convinced* becomes *feel* and then *believe*. Substitutions are the identical, as much as possible to preserve relevance, over the 15 claims to preserve the homogeneity of the results. A total of 38 lexical items are tested in various linguistic realizations. The goal is to validate the protocol and have preliminary results before starting a larger experiment.

The strength values are transformed into numbers to allow numerical computations. The following parameters are investigated:

- the strength  $S1$  associated with each lexical term: the different values associated with each lexical item are averaged, to produce their average individual strength estimate. Then, a partial ordering similar to the linguistic ordering presented in section 3.3 is constructed based on these values.
- the strength  $S2$  of a proposition  $P_i$ , elaborated from the individual strength of each element it is composed of, is then computed. This computation reflects the strength of combinations of several lexical items. Vectors are produced to represent all the lexical combinations, e.g.:

[lexical head L1, strength S1, lexical intensifier L2, orientation O, Resulting strength R].

For example:

[banished, 4, should, lower, 3].

- the strength  $S3$  of the support construction is elaborated in a similar way when it exists, it is equal to 1 when there is none,
- the global strength  $S4$  of the proposition including the support construction when it exists. For this level, the following vector is considered:

[support strength S3, proposition strength R, global strength G].

The results of this experiment are not very surprising:

- the individual strength of lexical items taken in isolation is very similar to the series developed independently of any context from a linguistic point of view, only 2 elements are classified differently,
- the proposition strength shows a variation of 15% compared to the linguistic estimate of section 3.3. It is lower in 80% of the cases. Most of the modals are interpreted as lowering the strength and a gradation is expected: moderate lowering and strong lowering, which would decrease the initial strength by 2 instead of just 1. The prominent role played by modals in the strength expression is an important result of this task,
- the support construction strength shows a variation of a maximum of 25% either above or below the linguistic estimate. This can be explained by the difficulty to interpret the strength of terms such as *believe* compared to *think*. These terms are in fact context and speaker dependent,
- the combination of the proposition and its support shows a variation of about 30% around the linguistic estimate, which is relatively large and questions the validity of the linguistic classification taken in isolation.

This simple and preliminary experiment shows that while there is a relative stability on the strength of terms such as verbs and adjective, the strength evaluation is less stable for modals, and needs some important adaptations for support constructions and their combination with or influence on the claim and vice-versa. This motivates the second step of our investigation: taking into account various forms of

context, which should allow to have a more reliable estimate of the strength of support constructions and modals.

## 4 OTHER FACTORS OF STRENGTH

Several other factors, which are essentially contextual, have a major influence on the strength of propositions  $P_i$  and on arguments more generally. Their influence is however difficult to accurately analyze. These factors are explored in this section. The results of the previous section (3.4) indeed show that the strength induced by some lexical items depends on the context of the utterance.

The first factor are the discourse structures which may be adjoined to a proposition or an argument that describe e.g. circumstances, conditions, restrictions, etc. This factor has been investigated within the RST framework (<http://www.sfu.ca/rst/>). The second factor is the argument scheme that has been used. Some have a higher strength or reliability than others. The third factor is the context of the proposition: it may be uttered in isolation or it may be part of a series of propositions  $P_i$  and of arguments. As developed in e.g. [18], propositions associated with a claim may be structured as series or in parallel. In the first case, the strength is the strength of the weaker one, and in the second case it is the strength of the strongest one. This type of factor is not found in opinion analysis where statements are in general treated in isolation. The fourth factor is the syntactic structure of the premise-conclusion pair where focus shifts can be observed via for example left-extrapolation. The last factor is the linguistic context of the utterance. For example some debates may only use soft arguments in order to remain polite and to avoid strong attacks, whereas others use extremely strong terms even for arguments which are not crucial.

In this section, the impact on argument strength of the first two factors is discussed. The remaining ones require additional investigations.

### 4.1 Influence of discourse structures on argument strength

As in any form of elaborated discourse, arguments are quite frequently associated with elements such as comments, elaborations, comparisons, illustrations, etc. which can be considered as either forms of explanation or secondary or subordinated arguments. These discourse structures are borrowed from the RST ([9], see also <http://www.sfu.ca/rst/>) considered within the perspective of argument strength analysis. These structures frequently implement argument schemes [21] and applied to opinion analysis [20], as developed in section 4.2 below. In our view, explanation is not a basic rhetorical relation as introduced in RST, but a very generic construction, a 'proto-relation', which covers a large number of communication and argumentative situations.

For the claim:

*Ebola vaccination is necessary,*

the statement:

*the Ebola vaccine is easy to use for emerging countries (cheap, can be transported without any need for refrigeration, active for a long time)*

is argumentative where the expression : '(cheap, can be transported without any need for refrigeration, active for a long time)' can be analyzed (1) either as an elaboration or as an illustration of the head expression 'easy to use for emerging countries' (2) or as a secondary or subordinate proposition which supports the main one. In RST theory, the head expression is a nucleus while the elaboration or illustra-

tion is its satellite. The explanation or secondary proposition which supports the main one increases the strength of ‘easy to use’.

However, the role of illustrations w.r.t. to argument strength is not easy to determine. Given the claim:

*I do not recommend this hotel,*

in a proposition such as:

*The bathrooms were in a bad condition: [ILLUSTRATION the showers leaked, and the plug mechanism in the bath jammed ...],*

the illustrations given to support the diagnosis (‘bad condition’) do not seem to reinforce or weaken its strength. They are interpreted as reformulations which are another way to say something without altering the initial content. The difference between these two examples is the contribution of the illustration: in the first example ‘easy to use’ is rather vague and is reinforced by the example, whereas in the second example ‘bad condition’ is more precise and remains at the same strength level.

Let us consider other types of discourse relations such as the circumstance and justification relations. For example, given the standpoint:

*Ebola is a dangerous disease,*

a justification may weaken a strong proposition, instead of supporting it:

[JUSTIFICATION in order to avoid any form of panic or, worse, of bio-terrorism], the authorities of Guinea claimed that there is no risk of proliferation of Ebola. In the following example, possibly with a form of irony, the strength and polarity of ‘breakfast is excellent’ is largely affected – if not reversed – by the contrast:

*The breakfast is excellent [PRECISION with very imaginative exotic fruit salads] [CONTRAST but most of the products are not fresh and most have passed their sell-by date].*

More complex – yet realistic – arguments associated with restrictions of various sorts make the identification of the overall strength quite challenging:

[CONTEXT We stayed here for a one day conference off-season], and the hotel was OK [CONCESSION - although the room I had was kind of weird.] I think it was the sitting room to the suite on the top floor [PRECISION - the bed was a fold-out bed, not comfortable, [CONCESSION (slept okay though)], and the coffee table was small, dirty and pushed to the side.] [CONCESSION It did have a lovely terrace though] - shame it was raining cats and dogs. [RECOMMENDATION Not a great experience.]

Depending on customers’ preferences, this opinion can be judged to be slightly positive or negative, in spite of the negative polarity of the recommendation, which turns out to be the main argument. Therefore, this opinion may either support or attack the standpoint *I do not recommend this hotel*.

Evaluating the impact of discourse structures is therefore a very challenging task. Even if the polarity and strength of each individual structure can be evaluated, their combination with the main argument and their interactions when there are several structures is complex and highly domain dependent. We are now exploring various types of experimental protocols which could contribute to this analysis. The discourse structures shown in the examples are recognized by our TextCoop platform with an accuracy of about 90% [14]. The challenge is now to go into the semantics of each structure.

## 4.2 The impact of argument schemes on argument strength

Another component to follow is to explore the inner structure of an argument and the underlying scheme that has been used. [21], [13],

have identified and structured a large number of schemes which are used in everyday argumentation. Some of them can be detected via a linguistic analysis [5], [7]. These can provide information on the strength of arguments. A number of schemes among the most frequently encountered are reviewed in this section.

### 4.2.1 Argument from analogy

The typical form of arguments from analogy is as follows:

Premise 1: Generally, case C1 is similar to case C2.

Premise 2: A is true (false) in case C1.

Conclusion: A is true (false) in case C2.

For example:

*It has been shown that vaccinating against malaria can be useless in some cases; similarly, the vaccine against Ebola is not recommended.*

This sentence makes an analogy between two serious diseases and tries to show that if the vaccine against one of these diseases is useless then the vaccine against the other is useless too. Some linguistic cues marking analogy are: *similarly, x is like y, doing x is as [adjective useful, dangerous, crucial] as doing y*.

Metaphors can also mark analogy. For instance, *Ebola is a war which has to be fought*. An analogy is made between Ebola and war. This type of construction has often been used in literature, some metaphors are now well-known and used in everyday conversations, which proves that its rhetorical effect is high; as a consequence, arguments from analogy may have a strong impact.

### 4.2.2 Argument from expert opinion

The typical structure of arguments from expert opinion is:

Premise 1: E is a reliable authority in the domain S.

Premise 2: A is a proposition contained in S.

Premise 3: E asserts that A.

Conclusion: Therefore, A.

An example of argument from expert opinion is :

*Depression and anxiety should be taken seriously. The London School of Economy reports that half of all illnesses in the under 65s is mental.*

In this example, the conclusions of a group of people who has expertise in the domain of health are used to support the claim that mental illnesses have to be taken seriously.

Arguments from expert opinion are marked by two linguistic cues; first, nouns which name the expert, e.g. *expert, doctor, economist, politician* etc.; second, constructions such as reported speech which allow indicating the expert’s opinion, e.g. *claim, warn, explain, indicate*, etc. The strength of these report verbs (as suggested in section 3.2) must be taken into account in the scheme. When there is no explicit cue, additional knowledge may be necessary to determine whether a person is an expert. For instance, *Stephen Hawking warned against risks linked to the development of AI* can only be understood as being an expert opinion if one knows that Stephen Hawking has long been working on Artificial Intelligence.

The opinion of experts is used in many cases to support a claim since it is hard to contradict an expertise. As a consequence, arguments from expert opinion have a strong impact. However, the strength of the argument can be critiqued by questioning the knowledge of the experts. For instance, in the above example, one may wonder whether the London School of Economy definitely has expertise in the health domain (see also Section 4.2.8).

### 4.2.3 Argument from negative consequences

This scheme has the following form:

Premise 1: If an action leads to bad consequences, all else being equal, it should not be brought about.

Premise 2: If action A is brought about, bad consequences will occur.

Conclusion: Therefore A should not be brought about.

*Vaccinating people against Ebola has reduced their immune system. This vaccine must not be used anymore.*

is an argument from negative consequences.

Negative adjectives and nouns are usually found in the premise(s) (here, *reduce*), while action verbs used in the negative form are used in the conclusion (here, *must not be used*). However, these cues are extremely domain dependent. Warning against negative consequences can have a strong impact, but the nouns and adjectives used can help determining how strong the argument is.

### 4.2.4 Arguments from examples

This scheme has the following form:

Premise 1: Example 1 is an example that supports claim P.

Premise 2: Example n is an example that supports claim P.

Conclusion: Claim P is true.

For example: *It has been shown that the vaccine is not the right solution. For example, two weeks after the injection, an old man died and the foetus of a pregnant woman shown malformations.*

Linguistic cues typical of the illustration discourse relation such as *for example, for instance, in the same manner* can contribute to detect the arguments from example. However, these cues are not always linguistically realized, for instance, the same argument could be presented as follows:

*Two weeks after the injection, an old man died and the foetus of a pregnant woman presented malformations. The vaccine is not the right solution.*

Evaluating how this form of strength interacts with the others, presented above, requires some experimentation. It is not clear, for example, if they all operate at the same level, or if some have a higher weight.

The strength of the argument can be measured with the number of examples used. The above argument has two premises (two examples) supporting the claim. The conclusion could be supported by many other examples of people who badly reacted to the vaccine, which would reinforce the claim that the vaccine is not the right solution.

### 4.2.5 Arguments from position to know

This scheme has the following form:

Premise 1: Source a is in a position to know about things in a certain subject domain S containing proposition A.

Premise 2: a asserts that A (in Domain S) is true (false).

Conclusion: A is true (false).

For instance: *A British politic visiting Western Africa has revealed that the number of deaths due to Ebola has dropped since the vaccination began. Vaccinating populations must therefore continue.*

In this example, the claim that vaccinating against Ebola must continue is supported by the opinion of a British political person. This type of argument is close to arguments from expert opinion. However, arguments from position to know are weaker than arguments

from expert opinion because it is easier to question whether the person who is being quoted has the right information. Similarly to arguments from expert opinion, reported speech can help detecting arguments from position to know.

### 4.2.6 Argument from popular opinion

Arguments from popular opinion take the following form:

Premise 1: Everybody is doing X.

Premise 2: X is a good thing to do.

Conclusions: Therefore, X must be the right thing to do.

As an example:

*vaccination in general is a cheap and efficient way to get rid of major diseases, therefore all populations exposed to Ebola must systematically undergo vaccination.*

Linguistic cues referring to populations and group of people can help detect arguments from popular opinion, e.g. *the population, people, individuals, everyone, all the persons*, etc. The use of numbers or percentages can also mark the strength of the argument. Similarly to arguments from position to know, arguments from popular opinion have less strength than the ones from expert opinion since the action (or opinions) of groups of people can be discussed.

### 4.2.7 Arguments from cause to effect

This scheme has the following form:

Premise 1: Doing X will cause Y to occur or If X occurs then Y will occur,

Premise 2: X is done or X occurs,

Conclusion: Y will occur.

The statement: *A new vaccine has been developed which will lower the number of deaths. The first vaccinations have begun last week. Less farmers in the vaccinated area will die after its injection.*

is an example of argument from cause to effect. This type of argument can be seen as an anticipation: future effects are foreseen; as a consequence, linguistic cues to detect such arguments are uses of future tenses or conditional. Anticipation has however little credibility in many cases, as a consequence, arguments from cause to effect are weak arguments.

### 4.2.8 Organizing schemes w.r.t. their strength

From the observations above, a tentative classification of argument strength induced by argument schemes can be made. In our case, no domain knowledge is considered, which could affect this classification:

Strong: analogy, expert opinion

Moderate: negative consequences, from examples

Weak: position to know, popular opinion, cause to effect.

In Walton, each scheme is associated with a number of critical questions which allow testing the soundness of the argument; these can be used to attack the argument. For instance, the argument from analogy has the following critical questions:

CQ1: Are there respects in which C1 and C2 are different that would tend to undermine the force of the similarity cited?

CQ2: Is A the right conclusion to be drawn in C1?

CQ3: Is there some other case C3 that is also similar to C1, but in which some conclusion other than A should be drawn?

Here are the critical questions for arguments from position to know:

CQ1: Is a in a position to know whether A is true (false)?

CQ2: Is a an honest (trustworthy, reliable) source?

CQ3: Did a assert that A is true (false)?

The critical questions for arguments from expert opinion are:

C1: Is E a genuine authority?

C2: Did E really assert A?

C3: Is E an authority in the right field?

Evaluating the overall strength of critical questions per scheme can be used to determine the strength of the scheme w.r.t. an argument. An argument which has stronger critical questions could be a weak argument (it can be easily attacked), or, on the contrary, it can be a strong one (it is difficult to defeat it).

Finally, the problem of fallacious arguments can interfere with the strength evaluation. For example, analogy is sometimes classified as fallacious. As (Walton et al. 2008, p 49) note: 'the problems seems to be that argument from analogy is a plausible form of argument only when it is used for guessing; it is not good enough to be used to prove a claim.' Evaluating fallacious arguments is a major concern in argumentation, however, in practical situations like ours, this means considering domain and general purpose knowledge and inferences.

## 5 CONCLUSION

In this contribution, we have surveyed a number of linguistic factors which contribute to the expression of argument strength. We proposed a categorization and a model to structure lexical items which may convey strength. We have outlined the elements which are proper to argument strength analysis and those which may be shared with opinion analysis. We have outlined, via a short experiment their sensitivity to context, taken in its broader sense: including the utterer, the listeners or readers, the domain and context of the arguments. In a second part, we have explored the impact of discourse structures and argument schemes on the expression of strength.

These different features show that it is difficult to evaluate a priori the strength of a a proposition that supports or attacks an argument. The weight of the different components of strength need a careful experimental analysis, and their interactions with context require the development of a model that includes language aspects as well as knowledge and specific forms of reasoning.

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