On Argumentation in Procedural Texts

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Abstract:
Procedural texts consist of sequences of instructions designed to reach an objective. The user must follow step by step the instructions in order to reach the results expected. In this paper, we explore the different facets of natural argumentation used in such texts that reinforces the plan-goal structure.

Keywords: procedural texts, plan-goal structure, natural argumentation.

Résumé:
Les textes procéduraux sont composés de séquences d’instructions visant à atteindre un objectif. L’utilisateur doit suivre étape par étape les instructions pour atteindre les résultats souhaités. Dans cet article, nous explorons les différentes facettes de l’argumentation contenue dans ce genre textuel servant à renforcer la structure plan-but des textes procéduraux.

Mots-clés: textes procéduraux, structure plan-but, argumentation.

Introduction

Procedural texts consist of a sequence of instructions designed with some accuracy in order to reach an objective (e.g. assemble a computer). In our perspective, procedural texts range from apparently simple cooking receipes to large maintenance manuals (whose paper versions are measured in tons e.g. for aircraft maintenance). They also include documents as diverse as teaching texts, medical notices, social behavior recommendations, directions for use, do-it-yourself and assembly notices, itinerary guides, advice texts, savoir-faire guides, etc.

In most types of procedural texts, in particular social behavior, communication, etc. procedural discourse has two dimensions: an explicative component, constructed around rational and objective elements (goals and plans), and a seduction component whose goal is (1) to encourage the user, (2) to help him revise his opinions, (3) to enrich the goals and the purposes, by outlining certain properties or qualities or consequences of a certain action or prevention. This seduction component closely associated with the rational elements, forms, in particular, the argumentative structure of the procedural text.
Another important feature, which is rather implicit, is the way instructions or groups of instructions are organized and follow each other, and both the logic (objective aspect) and the connotations (subjective aspects) that underlie this organization (sequential, parallel, concurrent, conditional, etc.).

In procedural texts, goals are, roughly, reached by means of sequences of instructions. These sequences are meaningful essentially w.r.t. the goals to reach. Similarly, the argumentative structure supports the execution of the instructions in various ways. Arguments get also their meaning w.r.t. the goals. The goal-sequences of instruction structure.

The diversity of procedural texts, their objectives and the way they are written is the source of a large variety of natural arguments. We briefly present them in this paper. This paper basically relates the argumentative structure of procedural texts as they are in French. This study is based on a extensive corpus study, within a language production perspective. This approach allows us to integrate logical, linguistic (e.g. Moeschler 1985, Anscombre et al. 1981) and philosophical views of argumentation. It is basically linguistic and conceptual.

In the remainder of this paper, we briefly outline the theoretical basis of argumentation, from an AI and cognitive perspective; we then present the structure of procedural texts. Then, we show the different conceptual and linguistic facets of arguments, as found in our corpora, and attempt to make explicit and categorize the roles these may play.

**Argumentation process and argument typology**

A rational agent can express claims and judgments, aiming at reaching a decision, a conclusion, or informing, convincing, negotiating with other agents. Pertinent information may be insufficient or conversely there may be too much, but partially incoherent information. In case of multi-agent interactions, conflicts of interest are unavoidable. Agents can be assisted by argumentation, a process based on the exchange and the valuation of interacting arguments which support opinions, claims, proposals, decisions,…

According to Dung (1995), an argumentation framework is defined as a pair consisting of a set of arguments and a binary relation representing the defeasibility relationship between arguments.

**Definition 1.** An argumentation framework is a pair \(<A, R>\) where A is a set of arguments and R is a binary relation representing a defeasibility relationship between arguments, i.e. \(R \subseteq A \times A\). \((a, b) \in R\) or equivalently “\(a \text{ R } b\)” means that the argument \(a\) defeats \(b\).

Among all the conflicting arguments, it is important to know which arguments will be kept for inferring conclusions and for making decisions. In (Dung, 1995), different semantics for the notion of acceptability have been proposed. Let’s recall them here.

**Definition 2.** (Conflict-free, Defence) Let \(B \subseteq A\).

- \(B\) is conflict-free iff there exist no \(a_i, a_j\) in \(B\) such that \(a_i \text{ R } a_j\);
- \(B\) defends an argument \(a_i\) iff for each argument \(a_j \in A\), if \(a_j \text{ R } a_i\) then there exists \(a_k \in B\) such that \(a_k \text{ R } a_j\).

**Definition 3.** (Acceptability semantics) Let \(B\) be a conflict-free set of arguments, and let \(F: 2^A \rightarrow 2^A\) be a function such that \(F(B) = \{a \mid B \text{ defends } a\}\).

- \(B\) is admissible iff \(B \subseteq F(B)\);
- \(B\) is a complete extension iff \(B = F(B)\);
- \(B\) is a grounded extension iff it is the minimal (w.r.t. set-inclusion) complete extension;
– B is a preferred extension iff it is a maximal (w.r.t. set-inclusion) complete extension;
– B is a stable extension iff it is a preferred extension that defeats all arguments in \( \Delta \setminus B \).

Let \( E = \{ E_1, \ldots, E_n \} \) be the set of all possible extensions under a given semantics.

Note that there is only one grounded extension. It contains all the arguments which are not defeated and also the arguments which are defended directly or indirectly by non-defeated arguments.

In the above framework, an argument is an abstract entity whose role is only determined by its relation to other arguments. Then its structure and its origin are not known. However, in many applications of argumentation, for instance for handling inconsistency in knowledge bases, arguments take the form of explanations, called in (Amgoud & Prade 2005) explanatory arguments. However, recent works on negotiation have argued that argumentation can play a key role in finding a compromise. Indeed, an offer supported by a ‘good’ argument has a better chance to be accepted by another agent. Argumentation may also lead an agent to change its goals and finally may constrain an agent to respond in a particular way. In addition to explanatory arguments studied in classical argumentation frameworks, works on argumentation-based negotiation have emphasized other types of arguments such as threats, rewards, tips and warnings (see section 5). For example, if an agent receives a threat, this agent may accept the offer even if it is not really acceptable for him (because otherwise really important goals would be threatened). The figure below shows clearly the differences between the four types of arguments.

The Context: Procedural text structure

Under the heading of procedural texts, there is a quite large diversity of texts. Procedural texts can be grouped into families according to their main objectives and style (Adam 2001). We have, for example, regulatory texts (Mortara Garavelli 1988), procedural texts (Longacre 1982), ‘programmatory’ texts (Greimas 1983), instructional-prescriptive texts (Werhlach 1975), injunctive texts (Adam 1987), advice texts (Lüger 1995) and recipe texts (Qamar 1996), etc. All these views share common structures: specification of goals, description of ingredients/materials to use, and description of sequences of instructions. Procedural texts obey to a number of structural criteria which are quite well-defined. They indeed share common stylistic forms, e.g. preference for imperative forms, and a number of typographic elements such as enumerations.

Procedural texts explain how to realize a certain goal by means of actions which are at least partially temporally organized; they also outline the way these actions can be realized,
with advices and preferences. The organization of a procedural text is in general made visible by means of linguistic and typographic marks.

Another feature is that procedural texts tend to minimize the distance between language and action. The main structure of procedural texts can refer to plans and goals theory in IA theory. In procedural texts, plans to realize a goal are made as immediate and explicit as necessary, the objective being to reduce the inferences that the user will have to make before acting. Texts are thus oriented towards action, they therefore combine instructions with icons, images, graphics, summaries, preventions, advices, etc.

We based our studies of procedural texts on their discursive aspects in order to identify and isolate the main informational modules that will be useful for answering procedural questions on the web in a QA system (see Aouladomar 2005 for more details).

Instructions may be sequential, or may have a more complex structure including, for example, options, alternatives or operations to realize in parallel with others. This level also includes the analysis of markers proper to certain types of instructions and markers that connect instructions.

The goal-plan structure of procedural texts has been described using a grammar formalism that presents the main elements composing procedural texts, that we use for annotating them.

The goals and sub-goals of procedural texts represent the skeletal structure of those texts. Every structure identified contributes to the realization of those goals.

**Methodology**

The methodology we use to represent the structure of procedural texts is based on corpora analysis. Our corpus is built following two steps: (1) a user-centred method, (2) an enhancement of this first corpus when important categories of procedural texts were missing.

First, we collect procedural queries from queries inventories on the web, which we use to select associated procedural texts. At the end of this stage, we gathered 78 texts from essentially technical (ex: computer assembly) and communication domains (how to write a CV). Then, we added 47 procedural texts from important missing categories (recipes, injunctions, etc.). The work presented below corresponds to a manual analysis of procedural texts in order to describe their organization. The description is based on example/counter example method.

**A Discursive analysis of procedural texts**

Procedural texts can be a simple, ordered list of instructions to perform to reach a goal, but they can also be less linear, outlining different ways to realize something, with arguments, conditions. They often also contain a number of recommendations, warnings, and comments of various sorts.

Here is, represented by means of a grammar, the structure we have elaborated for procedural texts from a corpora analysis.

Structures reported below essentially correspond to the organization of the informational contents. Elements concerning the layout (e.g. textual organizers such as: titles, enumerations, etc.), and linguistic marks of various sorts are used as triggers or delimiters in the implementation of this grammar. In what follows, parentheses express optionality, + iteration, { } express the compulsory character of an element but which is not always realized linguistically, the comma is just a separator with no temporal connotation a priori, / is an or and the operator < indicates a preferred precedence. Each symbol corresponds to an XML-tag, allowing us to annotate procedural texts.
Argumentation in procedural texts

General considerations

Argumentation is a process used by a person to convince an audience (Oléron 1983). Procedural texts are a form of argumentation structure since they (1) make interact the instructions producer and receiver, (2) are also a process that exert an influence on the receiver (the user must realize the instructions), (3) give justifications or elements that prove the appropriateness of the instruction, using rational elements (see our argument typology below).
Procedural texts are specific forms of discourse, satisfying constraints of economy of means, accuracy, etc. They are in general based on a specific discursive logic, made up of presuppositions, causes and consequences, goals, inductions, warnings, anaphoric networks, etc., and more psychological elements (e.g. to stimulate a user). The goal is to optimize a logical sequencing of instructions and make the user feel safe and confident with respect to the goal(s) he wants to achieve (e.g. clean an oil filter, learn how to organize a customer meeting). Procedural texts, from this point of view, can be analyzed not only just as sequences of mere instructions, but as efficient, one-way (i.e. no contradiction, no negotiation) argumentative discourses, designed to help a user to reach a goal, making the best decisions (see e.g. Amgoud et al. 2001, 2005).

Producing explanations is a rather synthetic activity whose goal is to use the elements introduced by knowledge explicitation mechanisms to induce generalizations, subsumptions, deductions, relations between objects or activities and the goals to reach. This is particularly visible in the lexical choices made and in the choice of some constructions, including typographic. Procedural discourse is basically interactive: it communicates, teaches, justifies, explains, warns, forbids, stimulates, evaluates. It contains a number of facets, which all are associated in a way to argumentation.

The author of procedural texts must consider different dimensions (Donin et al. 1992), among others: (1) cognitive: notions referred to must be mastered and understood by the target users, (2) epistemic: take into account, possibly to deny them, the beliefs of those users. The producer of procedural texts starts from a number of assumptions or presuppositions about potential users, about their knowledge, abilities and skills, but also about their beliefs, preferences, opinions, ability to generalize and adapt (to adapt instructions to their own situation, which is never exactly the one described in the procedure), perception of generic situations, and ability to follow discursive processes.

The producer of procedural texts has then, from this basis, to re-inforce or weaken presuppositions, to specify some extra knowledge and know-how, possibly beliefs or opinions. He has to convince the reader that his text will certainly lead to the success of the target goal, modulo the restrictions he includes. Texts are also expected to be locally and globally coherent, with no contradictions, and no space for hesitation or negotiation.

Given a certain goal, it is also of much interest to compare or contrast the means used by different authors, possibly for different audiences. Resorting to arguments for the producer of procedural texts can thus depend on several factors: the author beliefs, the type and the complexity of procedural texts (i.e. technical procedural texts are very rich in arguments compared to receipes), or the expertise level of users (i.e. a text designed for experts may contain less arguments than for non-experts of a domain).

Argumentation in procedural texts is found in the expression of objectives, in the expression of disjunction, alternatives, warnings, and within instructions (see the grammar above). Arguments are thus structurally and semantically dependent of the local structures or the general plans and goals structure they are associated with.

Definitions of arguments

Two families of arguments are found in the logical and psychological literature of argumentation, depending on the involvement of the producer of the argument: advices and inducements. In procedural texts, those arguments describe the reason why users could, should or must do the prescribed instructions.

– **Inducements** are speech acts uttered in an attempt to make another person do, or refrain from doing some actions (Fillenbaum 1986). They consists of either promises (rewards) or threats:
• A promise encourages an action \( p \) by offering \( q \) as a reward. (i.e. send the formula on time, and you will get a free installation of your phone line);
• A threat aims to deter behavior by pointing to potential punishment. (i.e. it is forbidden to smoke, to eat and to drink in the library. Non respecting these rules will lead to the immediate exclusion from the library).

– Advices involve recommendations about future behaviors. They consist of tips or warnings:

• A tip underlines potentially positive consequences for the addressee resulting from the satisfaction of \( p \). (i.e. use total sunblock with a high protecting coefficient, you will have a smooth skin even if white for long time);
• A warning highlights either (1) a negative consequence that will surely follow an action \( p \) unless one refrains from doing \( p \) or (2) a negative consequence that will likely ensue if one doesn’t realize \( p \). (i.e. Versez graduellement le lait froid, en fouettant vivement pour éviter la formation de grumeaux, N’utilisez pas d’acides de solutions chlorées, ces produits peuvent détériorer les sangles et nuire à l’intégrité de l’appareil. (gloss: pour gradually cold milk, whipping firmly in order to prevent the forming of lumps; don’t use chlored solutions, these products may damage straps and harm the integrity of the machine).)

Promises and threats express a more certain less probabilistic relationship between antecedent and consequent than do tips and warnings (Ohm 2005).

Besides these arguments, explanations are a neutral form of argumentation. They provide a motivation and an internal coherence to procedural texts. Explanations are the only arguments in procedural texts that can be used with any other kind of arguments. For example, in N’utilisez pas de laques pour les cheveux car elles ne sont pas adaptées au type de poil et risquent à la longue de le « casser », (gloss: don’t use hair spray because it is not adapted to the type of hair and it may break it), the first part argues for not doing \( p \), the second part is an explanation and the last part is a warning that both aims to motivate why the user must not realize \( p \).

From the analysis, mainly psychological or cognitive, of the different forms of procedural texts mentioned above (see section 3), we categorize procedural discourse into 4 main categories for our purpose:

– Procedures, e.g.: receipes, maintenance and construction manuals, some medical texts, etc.
– Injunctions, e.g.: orders, regulations, rules, security measures, etc.
– Advices/communication, e.g.: beauty advices, ways to fill in forms, administrative procedures, to behave in certain environments, how to manage a meeting, etc.
– Question answer pairs extracted from different FAQ’s on the web.

The table below summarizes the definitions of arguments, the author strategies and the procedural texts involved for each category of arguments.

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<tr>
<th>Types of arguments</th>
<th>Explanations</th>
<th>Inducements</th>
<th>advises</th>
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<tbody>
<tr>
<td>Definitions</td>
<td>Provide coherence to actions.</td>
<td>Encourage an action ( p ) by offering a reward ( q ).</td>
<td>Highlight positive consequences of an action</td>
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<td>Results of the wanted actions</td>
<td>Realization of the action to reach a positive result</td>
<td>Realization of the action to reach a positive result</td>
<td>Absence of a bad consequence</td>
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Schedule, 2006, prépublication n°2, (fascicule n°1, p. 13-22)
Typology of Arguments in procedural texts

Let us review here the 4 major forms of arguments we found frequently in corpora. Verb classes referred to are in general those specified in WordNet (Fellbaum 1998):

– explanations are the most usual ones. We find them in any kind of procedural texts. They usually introduce a set of sequences or more locally an instruction implemented in the “goal” symbol of the grammar.

The abstract schemas are the following: (1) purpose connectors-infinitive verbs, (2) causal connectors-deverbal and (3) titles.

The most frequently used causal connectors are: pour, afin de, car, c’est pourquoi, etc. (to, in order to) (e.g. to remove the bearings, for lubrication of the universal joint shafts, because it may be prematurely worn due to the failure of another component).

– warning arguments embedded mostly either in a “negative” formulation. They are particularly rich in technical domains.

Their role is basically to explain and to justify. Negative formulation is easy to identify: there are prototypical expressions that introduce the arguments.

Negative formulation follows the abstract schemas: negative causal connectors-infinitive risk verbs; negative causal marks-risk VP; positive causal connectors-VP negative syntactic forms, positive causal connectors-prevention verbs.

- negative connectors: sous peine de, sinon, car sinon, sans quoi, etc. (otherwise, under the risk of) (e.g. sous peine d’attaquer la teinte du bois);
- risk class verbs: risquer, causer, nuire, commettre etc. (e.g. pour ne pas commettre d’erreur);
- prevention verbs: éviter, prévenir, etc. (e.g. afin d’éviter que la carte se déchausse lorsqu’on la visse au châssis), gloss: in order to prevent the card from skipping off its rack);
- Positive causal mark and negative syntactic forms: de façon à ne pas, pour ne pas, pour que… ne… pas etc. (in order not to) (e.g. pour ne pas le rendre brillant, gloss: in order not to make it too bright).

– Tip arguments: these arguments are less imperative than the other ones, they are advices, evaluations. They are particularly rich in communication texts.

The corresponding abstract schemas are: causal connectors-performing NP; causal connectors-performing verbs; causal connectors-modal-performing verbs; performing proposition.

- performing verbs: e.g. permettre, améliorer, etc. allow, improve;
- performing PPs: e.g. Pour une meilleure finition; pour des raisons de performances;
- performing proposition: e.g. Have small bills. It’s easier to tip and to pay your bill that way.

– threatening arguments and reward arguments: these arguments have a strong impact on the user’s intention to realize the instruction provided, the instruction is almost made compulsory by using this kind of argument. This is the injunctive form.
We could not find any of these types of arguments in procedural texts, except in QA pairs and injunctions texts (e.g. rules) where the author and the addressee are clearly identified. Therefore, in those arguments we often find personal pronouns like “nous” “vous” (we, you). For threatening arguments, it follows the following schemas: otherwise connectors-consequence proposition; otherwise negative expression-consequence proposition:

- otherwise connectors: sinon;
- otherwise negative expression: si… ne… pas… (e.g. si vous ne le faites pas, nous le périmerons automatiquement après trois semaines en ligne).

For reward arguments, the schemas associated are the following: personal pronouns – reward proposition:

- reward proposition: using possession transfer verbs (gagner, donner, bénéficier, etc. (win, give, benefit …))

Besides these four main types of arguments, we found some forms of stimulation-evaluation (what you only have to do now…), and evaluation.

Conclusion

In this paper, we have shown the variety of natural argumentation forms found in procedural texts. To get a more accurate view of the diversity of argumentation in this type of text, we need to also consider more subtle language forms such as: modalisators, tonality, opinion marks, evaluation marks, illocutionary force in arguments, etc.

Let us conclude with some interesting observations and remarks that need to be developed by comparative analysis of different procedural texts.

- Using emphasizing arguments to express the importance of following instructions, can depend on the nature of procedural texts. Preliminary observations tend to show that technical procedural texts are richer in argumentation than, for instance, recipes. Arguments in procedural texts seem to depend also on the complexity or “dangerousness” of the procedure. Further investigations in those directions but also in the existence of specific syntactic and semantic schemas of arguments proper to different types of procedural texts would be interesting to carry out;
- Arguments can depend on the user’s expertise or familiarity with the domain. In that case, arguments are means, for the producer, of adapting his writing strategies according to the user.

All these considerations can lead to recommendations for writing assistance tools. Results can also help to develop different strategies when generating answers to procedural questions by: (1) adding arguments in the answer of a QA system which is a way to give justifications to the generated answer; (2) using arguments adapted to user levels.

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