Empowering Public Interest Communication with Argumentation - Project Report

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Abstract

The EPICA (Empowering Public Interest Communication with Argumentation) project aims to improve Public Interest Communication (PIC) through the use of advanced Computational Argumentation (CA) techniques. This paper provides a summary of the technical results of the project and discusses future research direction.

Keywords

Computational Argumentation, Public Interest Communications, Automated Reasoning

1. Introduction

In an era where digital communication rapidly shapes public opinion and social discourse, it is of paramount importance to ensure the effectiveness of Public Interest Communication (PIC) [1], which is used by institutions and organizations to address significant societal challenges and, in particular, to promote population health and well-being. The EPICA project (Empowering Public Interest Communication with Argumentation) started from the observation that the development of formal models and the use of information technology to support PIC activities are quite limited. It aims to integrate Computational Argumentation (CA) [2, 3] techniques into PIC strategies with the goal of providing innovative insights and tools to refine institutional communication practices. This paper provides a synthetic report of the activities carried out in the project up to the current date. In particular, Section 2 describes the main case study selected for the project, while Sections 3 to 6 summarize the result of the main Work Packages (WPs) of the project and Section 7 concludes.

2. Case Study: Greener Diet

As a use case, the EPICA project focused on public interest campaigns aimed at increasing fruit and vegetable consumption, following guidelines largely established by the World Health Organization [4]. These campaigns were selected because they share common goals in different countries and promote widely accepted claims about the topic. The health and environmental benefits of consuming fruits and vegetables are rarely questioned. Since the 1990s, such campaigns have been implemented in industrialized Western nations. However, post-campaign evaluations consistently reveal that target audiences often resist changing their dietary habits.

AI^3 *2025: 9th Workshop on Advances in Argumentation in Artificial Intelligence, September 13, 2025, Rende, Italy*
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Targeted questionnaires have uncovered the presence of strong, yet largely unspoken, counterarguments that influence behaviour without necessarily affecting individuals' beliefs [5]. Following [6], we frame the persuasive strategies used in greener diet campaigns as attempts to influence the behaviour intentions of individuals. These intentions are shaped by three key components:

- Attitude toward the behaviour (e.g., believing that eating vegetables is healthy);
- Subjective norm (i.e., the perceived social pressure to perform the behaviour);
- Perceived behavioural control (i.e., one's sense of self-efficacy regarding the behaviour).

This third component reflects non-attitudinal barriers that a well-crafted message can address. In the context of greener diets, such barriers include the cost of fruits and vegetables, taste preferences, and the effort required to cook vegetables. These factors create incoherence: people may believe in the benefits of fruits and vegetables but still fail to consume the recommended amount.

Because these counterarguments rarely emerge in public discourse, where the benefits of fruit and vegetable consumption are typically taken for granted, we argue that they should be explicitly identified and addressed during the planning phase of any public interest communication campaign on the topic.

3. Conceptual analysis and requirement definition

The first work package of the project has been devoted to draw a comprehensive conceptual analysis to identify elements of institutional PIC activities that can benefit from advanced CA techniques and to define requirements for the formalization of advanced argumentation models supporting PIC. The analysis has considered a sample of 5 initiatives devoted to promoting greener diet, which have been selected to ensure a variety in both the status of the promoting institutions, ranging from a national health authority to not-for-profit organizations and professional dietitians working for private companies, and in the forms of communication adopted, including institutional websites, a publicly available book, and Top 10 lists of reasons to eat more fruits and vegetables. The contents of the initiatives have been analyzed and compared with reference to the following aspects: the values (e.g., preservation of health, environment protection, sensory pleasure, etc.) promoted by the arguments in the campaigns; the argumentation schemes [7] adopted; the forms of argument presentation; the relationships (e.g., attack, support, specialization) holding between arguments; the importance ascribed to different arguments; the argument sources; and the temporal dimension. An articulated set of modeling requirements has been introduced concerning: the basic entities on which the models should be centered; the representation and properties of values and audiences; argumentation schemes, with particular reference to their combination and to the critical questions they include; the different presentation patterns that can be adopted for an argument based on a given scheme; capturing relationships both at the level of whole arguments and of their components; the formalization of argument importance and its dependence on other features like, in particular, the presentation order; the credibility of sources with respect to audiences; the evolution of campaigns over time. These requirements have been produced with an extensive approach, i.e. considering, deliberately, a set of features and advancements whose coverage is beyond the capabilities of a 2-year project, so as to provide a basis also for future developments. A selected subset of these requirements has been the basis for the activities of WP2, described in the next section. The conceptual analysis and requirements are presented in detail in the relevant deliverable [8].

4. Formal modelling

The second work package of the project has built on the analysis carried out in WP1. The requirements have been prioritised taking into account both their importance and their feasibility within the time span of the project. Accordingly, the activities have been focused on two main aspects:

- first, the *single audience* scenario has been addressed, and a new concept of "robustness" has been defined. Specifically, the robustness of arguments and sets of arguments is considered from the

point of view of the resistance of the *accepted* and of the *extension* status of arguments and sets of arguments, respectively, to changes in the audience preferences.
- then, the scenario of *diverse audiences* has been considered. The focus in this context has been on developing a mathematical model to quantify and analyse how different inferential and epistemic standards, as well as the influence of non-inferential components like promoted values, affect the assessment of public interest communication among varied target audiences.

As to the first scenario, a new paradigm for reasoning on the robustness of the status of (sets of) arguments in (single-audience) value-based argumentation frameworks has been introduced. In particular, we investigated the decision problems underlying the computation of the degree of robustness, and thoroughly investigated their computational complexity. The novelty of the contribution lies in the fact that robustness has never been studied in the literature of abstract argumentation with regard to audience profiling, but only, indirectly, within the framework of enforcement, which however did not consider some features which are crucial in our context. In particular, it does not take into account values and preferences and is focused on turning non-acceptance into acceptance, while the opposite problem of turning acceptance into non-acceptance is also crucial for robustness.

As to the second scenario, a vector-based extension of value-based argumentation has been proposed, introducing the concept of value vectors to represent a multi-dimensional spectrum of values influencing audience perception and response. A notion of impact measure has then been introduced, which aims to represent how combinations of weighted values associated with an argument are more or less effective with respect to the attitudes of different audiences, also represented as vectors of weights. On this basis, alternative notions of convincing arguments have been examined, referring either to the value of the impact measure *per se* or to how it affects the acceptability of arguments, evaluated using an argumentation semantics in the context of an argumentation framework [3]. Altogether it emerges that the identification of the most effective argument or set of arguments for a campaing depends significantly on the modelling choices adopted, confirming the importance of the notion of robustness in this context.

The activities carried out in WP2 are described in the relevant deliverable [9] and are documented in the papers [10, 11].

5. Model-based case analysis

We created a specialized corpus focused on campaigns promoting greener diets, with particular attention to increasing fruit and vegetable consumption. The corpus contains materials in both English and Italian. English-language campaigns were sourced from countries such as the United States, United Kingdom, Ireland, Canada, Australia, and New Zealand. Italian-language campaigns were exclusively drawn from initiatives targeting audiences in Italy. Data collection took place over a two-month period, from October to December 2024.

The dataset was built using a two-step methodology. First, we performed a manual Google search using queries like “fruit & vegetables campaign + country,” reviewing results from the first 15 pages. This was supplemented by ChatGPT searches, using prompts such as “Provide campaigns on fruit and vegetable consumption in + country” to identify additional content.

To ensure relevance and consistency, we applied strict inclusion criteria: just campaigns explicitly aimed at promoting fruit and vegetable consumption were selected. Broader public health campaigns (e.g., those focused on reducing salt intake or encouraging physical activity) were excluded. The final corpus includes 45 campaigns in total, 41 in English and 4 in Italian.

For each campaign with a dedicated website, all textual content was automatically extracted and subsequently processed through a pipeline designed to identify the minimal components of the argumentation.

We propose a pipeline for automatically inducing argument maps from text. The pipeline reframes traditional argument mining by focusing on textual entailment between extracted claims, rather than

relying solely on sequential identification–classification–relation labeling steps. This methodological choice was driven by the fact that, at present, there is no argument mining pipeline capable of identifying the basic argumentative units in a text, classifying them by type, and determining the relations that exist between them. The pipeline is composed of four steps:

- Claim Extraction: sentences are segmented and processed by a pre-trained model to extract elementary claims;
- Co-reference Resolution: extracted claims are disambiguated to resolve pronoun references and contextual ambiguity;
- Textual Entailment Analysis: all sentence pairs are evaluated using an LLM trained on Natural Language Inference (NLI) tasks to detect entailment, contradiction, or neutrality;
- Graph Construction: sentences and their entailment relations form a directed graph.

The root of the largest connected component is treated as the major claim. Nodes connected to it are interpreted as supporting claims or premises, based on their structural positions.

This approach, through processing of PIC campaigns content, aims at producing graph-based summaries of argumentative content that work even for partially argumentative texts and can be increased with arguments from other texts.

6. Reasoning algorithms and validation tools

Building on the foundational work carried out in WP2 and WP3, we focused on implementing the proposed reasoning algorithms and developing validation tools to present the approach to a selected group of users. In particular, starting from the work in [11] (the second scenario described in Section 4), we provided implementations for reasoning in the context of the vector extension to value-based argumentation. The tool we have developed[1] is designed to support the research and analysis in the context of public campaigns. It enables the measurement of the effectiveness of public interest communication by analysing arguments with respect to multiple values and audiences. Arguments are associated with value vectors that represent their affinity to various factors influencing audience perception and response. By examining these value dimensions, the tool provides insight into the impact of communication strategies on different audience groups.

Interaction with the tool takes place through a web application and is structured into three steps: *campaign definition*, *visualisation*, and *analysis*. The campaign definition step allows users to model a campaign of public interest. The user can upload or paste a JSON file describing the entire campaign or, alternatively, use a dedicated form to enter each individual component. These components include positive arguments, arguments, attacks, audiences, and values associated with both arguments and audiences.

The visualisation step allows users to explore key aspects of the campaign. First, the tool shows the impact measure of each argument for different audiences. It then presents the computed defeat relation ($\twoheadrightarrow$) among arguments for all audiences, highlighting which attacks loose effectiveness with respect to the initial framework. Finally, the grounded semantics is computed and displayed for the framework $\langle A, \twoheadrightarrow \rangle$. The resulting set of arguments represents those considered convincing within the context of the campaign. The web page also includes an interactive graph that represents the campaign and allows modification by adding or removing arguments and attacks.

The last step is the analysis one, which implements two goal functions to identify the most effective positive arguments in the campaign for convincing the audience. The first objective, "Overall Effectiveness", seeks the argument that maximises the weighted sum of its impact across all audiences. The second objective, "Convinced People", identifies the argument that maximises the weighted number of audiences it successfully convinces. The scores of each argument with respect to the two goals are displayed in a table.

[1]The tool can be accessed online at the following link: https://epica.dmi.unipg.it/tool/.

7. Conclusions

The EPICA project is at an advanced stage of development. It first developed a broad conceptual analysis and defined an extensive set of requirements concerning the use of computational argumentation techniques to support Public Interest Communication, with a special focus on the selected case study namely the promotion of a greener diet. Based on a selected set of the identified requirements, formal models have been developed considering issues like robustness and effectiveness of communication campaigns, with reference to scenarios involving both single and multiple audiences. To support the analysis and the validation of the proposed models in the context of the selected case study, a corpus focused on campaigns promoting greener diets has been developed. It results from an activity of data collection concerning campaigns carried out in a variety of countries worldwide, followed by an automated extraction phase, based on a suitable adapted mining pipeline. Finally, a prototypical tool implementing the proposed reasoning algorithms and supporting the selection of the most suitable arguments for a given campaign has been developed. The tool is available online and allows user to introduce and modify interactively the design of their communication initiatives. Among the future work directions, we mention further developments and refinements of the formal models, their validation using the developed dataset, the experimentation of the implemented tool with communication experts, and the dissemination of project results through events directed to relevant communities of stakeholders.

Acknowledgments

This work has been supported by MUR project PRIN 2022 EPICA (Master CUP D53D23008860006, unit CUPs J53D23007220006, H53D23003660006, B53D23013230006), funded by the European Union - Next Generation EU, mission 4, component 2, investment 1.1.

Declaration on Generative AI

The author(s) have not employed any Generative AI tools.

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