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► **To cite this version:**

Nicolas Salliou, Rallou Thomopoulos. Modelling multicriteria argument networks about reduced meat consumption. FOODSIM 2018 - 10th International Conference on Simulation and Modelling in the Food and Bio-industry, European Multidisciplinary Society for Modelling and Simulation Technology (EUROSIS). BEL., Apr 2018, Ghent, Belgium. pp.1-6. hal-01837516

HAL Id: hal-01837516

<https://hal.science/hal-01837516>

Submitted on 2 Jun 2020

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MODELLING MULTICRITERIA ARGUMENT NETWORKS ABOUT REDUCED MEAT CONSUMPTION

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KEYWORDS

Food diet modelling, Argumentation systems, Animal food product, Consumer, Food choice criteria.

ABSTRACT

A second nutrition transition seems to emerge towards more plant-based diets, curbing meat consumption in developed countries in the beginning of the XXI century. This shift suggests that logical arguments tend to influence more and more individuals towards vegetarian diets. This paper proposes a methodology to model a network of arguments around vegetarian diets by an abstract argumentation approach. Each argument, formalized by a node is connected with other arguments by arrows formalizing relationships between arguments. Thanks to this methodology we were able to formalize an argument network about vegetarian diets and identify the foremost importance of health argument compared with ethical or other type of arguments. This methodology also identified key arguments due to their high centrality in being challenged or challenging other arguments. These first results from this argument network construction suggest that any controversy surrounding vegetarian diets may polarize around such high centrality arguments about health. Even though ethical arguments appear of low importance in our network, the key issue of the necessity of animal products for human health may be essential for ethical choices towards vegetarian diets.

INTRODUCTION

The first nutrition transition involved the rise of sugar, fat, meat and processed products in human diets (Popkin 1993) and is the dominant nutritional model today. Vranken (2014) identified a second nutrition transition happening in the most developed countries where meat consumption is currently curbing down. Transition towards reducing meat consumption covers a wide variety of practices

ranging from occasional vegetarianism to veganism (also called “strict vegetarian”) (Bearsworth & Kiel 1991). Rationale for such transition mainly implies ethical and health concerns (Jabs et al. 1998) but environmental impact of meat consumption is also stressed on a lower degree (Ruby 2012). MacDonald (2000) conducted individual interviews with vegans and found that their nutritional transition depended on a catalytic experience orienting individual towards information acquisition and ultimately conducting to a decision for change. However, the information acquisition leading to decision is not precisely known among vegetarians. In this paper we present a methodology to explore main arguments and their relations between them that transitioning individuals may face during this process.

METHOD

General approach

In order to model arguments involved with vegetarian transitions we used an abstract argumentation approach (Dung 1994, Rahwan & Simari 2009, Thomopoulos & Paturel 2017). We extracted arguments in favor or not of reducing animal product consumption. Our sources of arguments are newspapers, grey literature and top ten google research (“vegetarian diet”; “vegan diet”; “vegetalism argument”). The latter inquiry added to the pool popular scientific papers, webmedia articles and blog posts. We read thoroughly each source and extracted all arguments as expressed by their author. For each argument we attributed a criterion (“Nutritional”; “Economic”; “Environmental”; “Anthropological”; “Ethical”; “Health” or “Social”) and noted the source expressing this argument (“Journalist”; “Scientist”, “Philosopher”; “Blogger”, etc.). We consequently obtained 114 arguments.

The argumentation formalism

Let us recall that an argumentation system is usually represented as an oriented graph where nodes are

arguments and edges are attack relations between arguments (Figure 1).

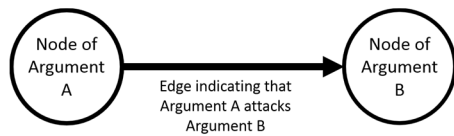


Figure 1: General graphical representation of an argumentation system

Considering Dung's seminal work on argumentation (1995), an argument and the attack relation are abstract and can be instantiated and defined in different ways in different contexts (Walton, 2009). Dung himself stated: "an argument is an abstract entity whose role is solely determined by its relations to other arguments. No special attention is paid to the internal structure of the arguments". For example, an argument can be a set of statements composed of a conclusion and at least one premise, linked by an inference or a logical relation. Attacking an argument can be achieved in different ways: 1) by raising doubts about its acceptability through critical questions; 2) by questioning its premises; or 3) by putting forward that the premises are not relevant to the conclusion or 4) by presenting an argument with an opposing conclusion. In all these cases an attack relation is said to exist (e.g Figure 2).

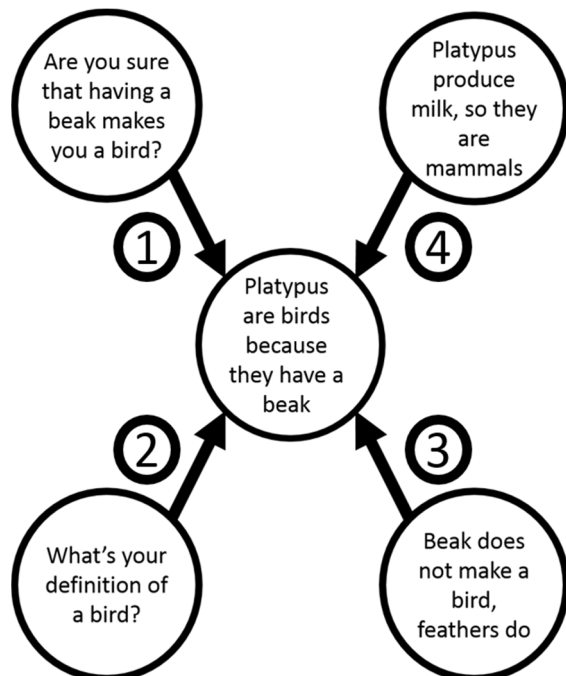


Figure 2: Examples of four types of attacks. 1: Raising doubts; 2: Questioning premises; 3: Irrelevant premises; 4: Opposing conclusions

Even though Dung's framework is theoretically sound it is not straightforward to apply in real life situations. Indeed, one of the initial difficulty is to how to define an argument in order to properly reflect stakeholders' statements in a debate. Unfortunately, there is still no general model that can be used to formalize a natural argument (i.e. an argument stated by a stakeholder during a discussion in natural language) and input in an abstract argumentation framework in a real decision-making context. Quoting Baroni and Giacomin (2009): « *While the word 'argument' may recall several intuitive meanings, like the ones of 'line of reasoning leading from some premise to a conclusion' or of 'utterance in a dispute', abstract argument systems are not (even implicitly or indirectly) bound to any of them: an abstract argument is not assumed to have any specific structure but, roughly speaking, an argument is anything that may attack or be attacked by another argument* ». Indeed, the structure of an abstract argument does not correspond to the intuitive understanding of what an argument is. Moreover, the notion of "attack between arguments" does not have a natural and direct correspondence to practical expressions used by stakeholders when debating. Moreover, representing arguments as an oriented graph can be a difficult task for stakeholders: when the number of arguments and/or attacks is large, the graph becomes illegible and difficult to interpret by stakeholders.

In our project, we needed to find a practical way of defining arguments that are used in the process of decision making. In such a context arguments can be intuitively thought of as being statements to support, contradict, or explain opinions or decisions (Amgoud & Prade, 2009). More precisely, in decisional argumentation frameworks (Ouerdane et al., 2010), the argument definition is enriched with additional features, namely the decision (also referred to as 'action', 'option' or 'alternative') and the goal (also referred to as 'target'). In other studies arguments are also associated with specific actors. An application of a decision-oriented argumentation framework to a real-life problem concerning food policy can be found in Bourguet et al. (2013), where a recommendation regarding the provision of whole-grain bread was analyzed a posteriori. In this case, each argument is associated with the action it supports. Based on the above rationale, we chose to specify an argument as a tuple composed of an identifier, a type, an explanation, a criterion, an option and a sub-option. Formally:

An argument is a tuple $a = (I;T;S;R;C;A;Is;Ts)$ where:

– I is the identifier of the argument;

- T is the type of the argument (with values *in favour of*, denoted by '+', or *against*, denoted by '-', the vegetarian option);
- S is the statement of the argument, i.e. its conclusion;
- R is the rationale underlying the argument, i.e. its hypothesis;
- C is the criterion which the argument relies on;
- A is the actor who proposes the argument;
- Is is the information source containing the argument;
- Ts is the type of source the argument comes from.

For any argument a , we denote by $I(a)$, $T(a)$, $S(a)$, $R(a)$, $C(a)$, $A(a)$, $Is(a)$, $Ts(a)$ respectively the

identifier, the type, the statement, the rationale, the criterion, the actor, the information source and the information type of argument a .

As an illustration, Table 1 displays a sample of the set of arguments considered in our case study.

Table 1: Sample of Arguments Tuples about Reduced Meat Consumption (I: Identification; T: Type; Is : Information source; Ts: Type of source)

I	T	Statement	Rationale	Criterion	Actor	Is	Ts
1	-	Vegan diet is deficient in B12 vitamin	Vegetal proteins do not contain B12 vitamin	Nutritional	Journalist	Canard Enchaîné - 144 - Juillet 2017	Newspaper
15	-	Plant proteins trigger allergies	Plant-based food are more regularly allergic	Nutritional	Innovation cluster	Valorial	Powerpoint
23	+	Vegetarian diet is good for health	Diabetes, cancer and coronary risks are reduced	Health	Scientists	Tilman & Clark 2014	Scientific paper
28	+	Properly planned vegan or vegetarian diets fits all stages of the life cycle	Nutrient needs are satisfied and growth is normal	Health	American Dietetic Association	Craig et al. 2009	Scientific paper
43	+	Vegan diet improves the rheumatoid arthritis activity	A diet-induced faecal flora change was observed	Health	Scientists	Peltonen et al. 1997	Scientific paper
55	+	Eating meat is not in human's nature	It was sometimes necessary in the past to eat meat, not nowadays	Anthropological	Blogger pro-vegan	Blog - Eleusis et Megara	Blog post
56	+	Stop eating animals does not mean animal extinction	Deforestation for the cultivation of animal feed provokes species extinctions;	Environmental	Blogger pro-vegan	Blog - Eleusis et Megara	Blog post
59	+	Animals suffer when eaten, not plants	A nervous system is needed to suffer, which plants do not have.	Ethical	Blogger pro-vegan	Blog - Eleusis et Megara	Blog post
71	-	No study is favorable to the vegan diet	One good quality study show that Atkins diet is better that Ornish diet	Health	Journalist	Signs Of The Times	Internet article
77	-	No health reason justifies to avoid animal products	Human body is adapted to eat animal products for millions of years	Health	Journalist	Signs Of The Times	Internet article

Now, let us consider the attack relation. In structured argumentation (i.e. logic based argumentation frameworks where arguments are obtained as instantiations over an inconsistent knowledge base) three kinds of attacks have been defined: undercut, rebut and undermine (Besnard & Hunter, 2008). The

intuition of these attack relations is either to counter the premise of the opposing argument ('undercut'), the conclusion ('rebut') or to attack the logical steps that allowed the inference between the argument's premise and conclusion (undermine). In abstract argumentation the set of attacks is simply considered

as provided *a priori*. Another possibility that can be considered is to enhance the argumentation framework with a set of preferences, expressed for instance as weights representing uncertainty. In our project we needed to choose a practical way to define the attack relation. Considering the reality of stakeholders' debates and our model to formalize arguments, we chose to model the attack relation in the following way. Attacking an argument *a* is achieved by: 1) **explicitly** raising doubts about its acceptability by expressing a counter-argument citing *a* or the information source containing *a*; 2) **implicitly** raising doubts about its acceptability by expressing a counter-argument contradicting *a* through undercut, rebut or undermine. Formally, we consider the following attack relation:

Let *a* and *b* be two arguments. We say that *a* attacks *b* if and only if the following two conditions are satisfied:

- 1) $T(a) \neq T(b)$;
- 2) $\{R(a), S(a)\} \rightarrow \text{not } \{R(b), S(b)\}$.

The first condition expresses that arguments *a* and *b* are one in favour and the other against the vegetarian option. The second condition expresses the inconsistency of *a* and *b*.

Modelling arguments and attacks

Each argument was first formalized by an identification number, whether is in favor or not of meat reduction diets (+/-), its main statement and

rationale such as: "Vegan diet is related with B12 vitamin deficiency" (Statement) as "plants do not contain B12 vitamin" (Rationale). Other information (Actor, Information source & Type of source) characterize the origin of the argument. Based on this first step we then formalized attacks between them. An attack occurs when an argument is contradicting another one. For example the argument "1" quoted above is contradicted by the following argument "28 - Properly planned vegetarian or vegan diets fits all stage of life" as "Nutrient needs are satisfied and growth is normal". When these arguments are formalized graphically each one is represented as a node and an attack is a vertex connecting both arguments, the arrow pointing the direction of the attack. In our case study, we identified 155 attacks connecting 55 arguments among our total of 114.

Graphical representation of the argument network

In order to make a graphical representation of the argument network we used the visualization program Yed Graph Editor (version 3.17.1). We choose to represent only arguments which are connected with at least one attack. Each argument node received a specific color according to the source expressing the arguments. For visualization purposes, we grouped together identical arguments when repeated and coming from the same source (Figure 3).

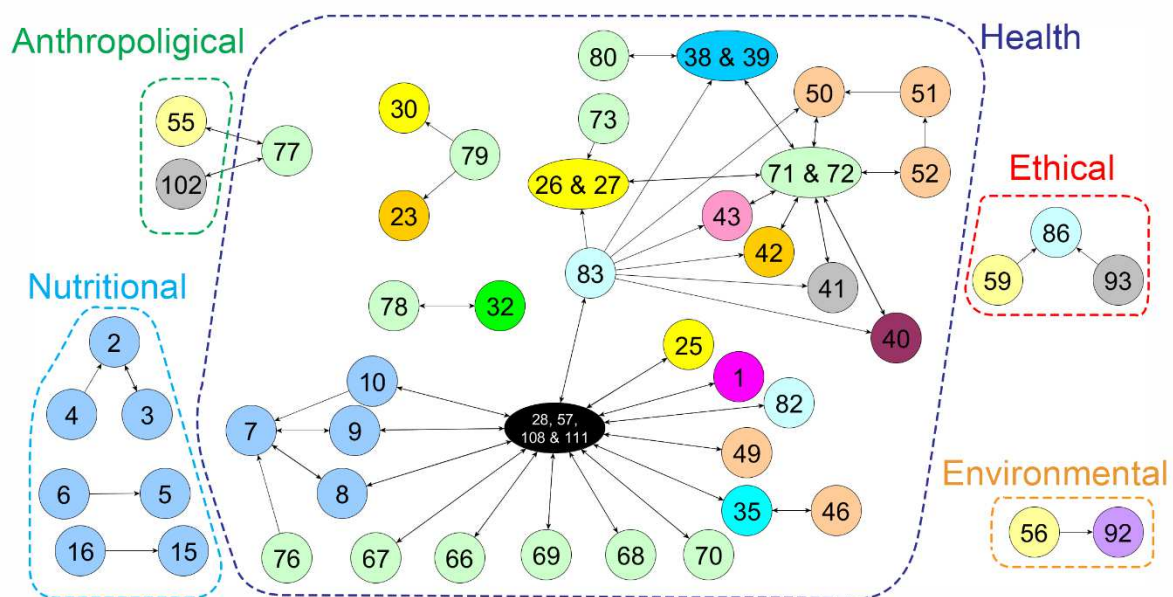


Figure 3: Graphical Representation of Arguments and Attacks about Reduced Meat Consumption. (Each number corresponds to one argument express by one source. Each source is represented by one node color except for similar arguments which have been group together. Arguments have been grouped by category.)

MAIN LESSONS AND PERSPECTIVES

Our argument network structure reveals in particular two main elements. First, one can notice that arguments about Health are by far the majority of arguments identified. They represent 47% of all 114 arguments identified and 63% of arguments involved in at least one attack. As a matter of comparison ethical arguments represent only 3% of all arguments identified. Second, some key arguments are emerging due to their centrality. Two arguments are involved in more than 3 attacks. The first argument, grouped under identification numbers 28, 57, 108 and 111 (the black node in Figure 3), refers to a scientific paper from the American Dietetic Association stating that “Properly planned vegetarian or vegan diets fits all stage of life” (Craig & Mangels 2009). The second argument, identification number 71 and 72 grouped together, is a journalist statement that “No study is favorable to the vegan diet”. Both arguments would probably be key arguments in potential controversy about vegetarian diets due to their generality.

The major importance of health issues surrounding vegetarian diets are in line with findings in Ruby’s (2012) review of vegetarian studies. On the opposite, the importance of ethical arguments which was stressed by Ruby (2012) did not appear in such modelling. This could be explained by the more complex nature of ethical arguments as well as our choice of research keywords in Google which focused on diets. However, from an ethical perspective it seems that the health issue (whether or not vegetarian diets are healthy) is actually central as animal rights may be defended from the baseline of animal products not being necessary for human health (Francione & Charlton 2013).

In this research we built the network and proposed a structural analysis. Abstract argumentation opens further analysis and in particular the rejection of attacked arguments without any argument to defend them. Such analysis allow for new indicators such a polemical indicators based on rejected argument ratios (Thomopoulos & Paturel 2017) which can better identify potential controversies. Following the theoretical approach of Xie et al. (2011) such argument network could also be used together with agent-based modelling to explore emergent establishment of new social norms on the concrete case of vegetarianisms. Such model could help to understand the conditions under which such arguments could spread in a population and favor vegetarian diets normalization.

CONCLUSION

The method presented in this paper formalizes arguments and attacks around vegetarian diets using an abstract argumentation approach. The argument network revealed the foremost importance of health issues surrounding vegetarian diets. The centrality of some argument of the network allows for identification of potential key arguments and/or controversies. The importance of health arguments in relation with ethical argument should be further researched.

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BIOGRAPHIES

SALLIOU NICOLAS was born in Rennes, France, and has been trained in agricultural development at AgroParisTech and specialized into social change and participatory modelling. He obtained his PhD in 2017 at the Institut National Polytechnique of Toulouse where he conducted a participatory modelling process about farmer's agroecological transitions.

THOMOPOULOS RALLOU has been INRA Research Scientist since 2004, permanent member and co-creator of the GraphIK lab at INRIA. She defended her HDR (habilitation to conduct research groups and PhDs) in 2013 at the University of Montpellier. She has dual skills in computer science and the agri-food sector. Her research topics are in knowledge representation and decision support, focused on argumentation systems, about agri-food systems. She was a Guest Research Scientist at Laval University (Canada) in 2015-2016 and previously 5 year Assistant Professor at AgroParisTech.