User Information Needs for Environmental Opinion-forming and Decision-making in Link-enriched Video

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ABSTRACT

Link-enriched video can support users in informative processes of environmental opinion-forming and decision-making. To enable this, we need to specify the information that should be captured in an annotation schema for describing the video. We conducted expert interviews to elicit users' potential information needs. We carried out a user survey to assess the relevance of the identified information types. Finally, we observed users' behaviour and needs when presented with a selection of video segments. Our results indicate that certain types of information about the environmental problem, the opinions expressed, the people expressing them and the sources are more relevant for users.

Categories and Subject Descriptors

H.5.4 [**Hypertext/Hypermedia**]: User issues

Keywords

User information needs, link-enriched video, opinion-making, decision-making, interactive TV, environmental issues

1. INTRODUCTION

The deterioration of the ecosystems on which we depend is currently one of the most important international concerns we face. The participation of informed citizens in the debate on decisions affecting sustainable development of our society is fundamental to addressing these issues [6]. Television plays a key role in providing audiovisual information, where producers and broadcasters decide on what content to broadcast and when to broadcast it. Internet, on the other hand, provides access to vasts amounts of hyperlinked information that can be browsed, shared, modified and reused, enabling the satisfaction of a broader spectrum of information requirements.

Audiovisual content is particularly relevant because it enables the communication of extensive amounts of information quickly, as well as conveying feelings, emotions and abstract interactions, which are difficult to express through other media [15]. By combining the potential of audiovisual information to engage and entertain with the capacity of digital hypermedia to connect ideas, link-enriched video can in principle enhance the processes of opinion-forming and decision-making in the context of environmental issues.

Our challenge is to identify the information that should be captured in video annotations that will support the enrichment of video broadcasts with information that is pertinent to users, for example for search and retrieval purposes. The main problem is the gap between what users' need and what content providers can do to meet these needs within their time and budget constraints. In this paper we specify the information that should be captured in an annotation schema for link-enriched video that is able to support users' information requirements in the processes of opinion-forming and decision-making on environmental issues. To this end, two specific objectives are proposed:

1. To identify information that can be provided to users to support them in forming opinions and making decisions on environmental issues.

2. To identify and prioritise users' information requirements for link-enriched video to support users' opinion-forming and decision-making on environmental issues.

We carried out the study in two phases:

1. Divergence phase. We made an inventory of the types of information contained in environmental videos and we gathered user information needs in link-enriched video through: a) a literature review (section 2) to investigate the potential of link-enriched video, determine implications for video annotation, understand persuasion processes involved in opinion-forming and ascertain types of information that users might need. We then conducted expert interviews (section 3) to consolidate and broaden the spectrum of types of information that users need and to determine their implications for video annotation.

2. Convergence phase. We selected specific user requirements from the broad spectrum elicited in the previous stage conducting: a) a user survey (section 4) to gain insights into the information and tools that users claim they need; and b) a user experiment (section 5), to directly observe the types of information that participants used when forming opinions and making decisions on environmental issues.

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2. RELATED WORK

Environmental issues are notoriously complex, and require the understanding of different types of information from many perspectives [18, 16]. Opinion-forming and decision-making require "a complex search for information, full of detours, enriched by feedback from casting about in all directions, gathering and discarding information, fueled by fluctuating uncertainty, indistinct and conflicting concepts" [18](p.86). Link-enriched video has the potential for rapid information location within collections of video material by allowing users to select content segments, jump to related information during playback, and return to material earlier in the sequence or a previous fragment [9].

We present a number of information types that describe aspects of environmental videos and that provide an initial framework for the study of information requirements for opinion-forming and decision-making. Specifically, we discuss the following topics: video annotation for describing the video content (section 2.1); the persuasion processes underlying opinion-forming and decision-making (section 2.2); the types of information needed (section 2.3).

2.1 Video annotation

In order to create link-enriched hypervideo, audiovisual content requires content annotations to facilitate the automatic creation of links among the video sequences for manipulating, searching and retrieving video [5](p.25). An annotation structure associates spatio-temporal features of the video format with concepts pertinent to the domain of discourse [2]. A video clip consists of scenes that are groups of shots, and shots are sequences of contiguous video frames [17]. A video segment or fragment is any contiguous portion of a clip. Annotations can be associated with any level of the video structure, whether clip, fragment, shot or complete film [4] (p.44). Concepts associated with these in an annotation structure can be in the form of free text, predefined keywords, a taxonomy, a thesaurus or an ontology [4] (p. 44).

The knowledge encapsulated in video annotation should support search and retrieval and other repurposing tasks, such as resequencing on the fly by a wide range of users [5] (p. 45). To repurpose video content to allow its exploration for the purpose of environmental opinion and decision-making we need to specify the information that should be captured in the video annotations.

2.2 Models of persuasion

Elaboration likelihood model of persuasion.

Traditional models of persuasion propose that people evaluate messages mostly on the basis of their perceived position and on the basis of their past experiences (people tend to agree with people they like). Messages are contrasted and rejected if they appear too discrepant, but are assimilated and accepted if they appear closer to one's initial position [12]. In addition to the relatively simple acceptance/rejection rules proposed by these models, the elaboration likelihood model of persuasion [12] provides a framework for understanding the processes underlying the effectiveness of persuasive communications and the way attitudes are formed and changed.

The concept of 'elaboration' refers to the generation of one's own thoughts in response to the information to which one is being exposed and to the extent to which one thinks about the arguments contained in a message. Due to cognitive constraints that prevent people from processing all of the messages to which they are exposed, the level of elaboration varies. Where elaboration is high, persuasion occurs through the so-called central route, where evaluation and critical thought are required. Persuasion occurs through the peripheral route when other characteristics of the message, such as the perceived credibility of the source, the quality of the way in which it is presented, the attractiveness of the source, or the catchy slogan that contains the message, are more dominant. The elaboration likelihood model provides key concepts that enable us to analyse, explain and understand aspects of user behaviour and needs when forming opinions.

Means of persuasion.

The goal of spoken or written argumentation is to persuade the audience that the ideas presented are valid. Aristotle et al. [1] divided the means of persuasion in three categories: logos (logical), which is related to logic or reason and refers to arguments that are based on factual data; pathos (emotional), that appeals to emotions and is related to the way the audience feels when considering the argument; and ethos (credibility), that appeals to the reputation of the speaker and its trustworthiness. Bocconi et al. [4] (chapter 4) proposes modelling logos, pathos and ethos to enable automatic video generation. The means of persuasion provide a framework for the analysis of information available in audiovisual content, in particular in which speakers express their position regarding an environmental problem.

2.3 Types of information

Details about the environmental problem.

Environmental issues are complex, involving numerous connections across physical media, time and space [16]. In order to provide details about an environmental issue, the problems' key elements and their relationships must be considered [13].

Types of issue. Sexton [14] proposes 10 types of environmental problems: air quality control, critical natural areas, energy production/distribution, green technologies, natural resource management, historic, cultural and aesthetic resources, urban infrastructure/growth management, waste management, water allocation and water quality control.

Spatial dimension. The size of an area affected by a specific issue can vary, and even where an issue applies to a specific area, the level of impact in other areas may also be relevant. Classifying issues into those that affect small or large areas can be difficult, as many problems involve both international and local levels. The point is not to precisely pin down a spatial dimension, but rather to identify the places and areas that are more, or less, affected by the problem in question [14].

Stage of the attention cycle. Downs [7] claims that all social problems go through the following stages: pre-problem stage, alarmed discovery and euphoric enthusiasm, realizing the cost of significant progress, gradual decline of intense public interest and post-problem stage.

Lessons learned. Because flawed decisions are a fundamental cause of environmental problems, it is imperative that people discern which past decisions were faulty [14].

An important aspect of decisions concerns learning, since decision situations are constantly changing [3].

Outcomes. Outcomes could be provided at different levels: international, national, regional, locality, community group, household, individual [14].

Actors involved.

Important aspects in decision making involve eliciting judgments that reflect knowledge, feelings, or emotions of the actors involved in the issue [13]. Information about the individual presenting a position or discussing the problem is relevant for processes of making opinions and decisions [14, 13]. Sexton [14] identified the following types of actor: governments, regional governmental organizations, business associations, environmental advocacy groups, community or neighborhood groups and affected or interested individuals.

Opinions.

When environmental problems are in discussion, actors express their opinions. Different aspects of individual opinions can be taken into account [10]: direction of an opinion (whether it is pro or con – favorable or unfavorable); degree (or extremity) of an opinion; salience (personal interest in the issue); and intensity (with which opinions are hold). Similar aspects can be analysed on the public opinion, which is the aggregation of individual opinions [10]: distribution (proportion of the public falling into each of the various direction/degree categories); extent of consensus; saliency; and intensity. Typically, when people state their opinion or position, they do so with the intention to persuade or prove that their conclusions are correct [4].

Dimensions of analysis.

Falkenmark [8] analyses environmental governance from 3 perspectives: the biophysical system, the social system, and the governance system. Sexton [14] proposes 7 dimensions of environmental issues: social, economic, cultural, political, scientific, ethical and technical.

2.4 Discussion

The enrichment of video content to enable opinion-forming and decision-making needs to take into account the different means of persuasion involved. For example, messages expressed through videos could be enriched with information stating to what extent they appeal to the users' logic, emotions or pathos. Providing information about the issue itself, the actors involved and explanations from diverse perspectives is required to enable the processes of opinion-forming and decision-making. For searching for and retrieving of videos, representing aspects of the opinions and the means of persuasion involved can also be useful. We use this groundwork on models of persuasion and information required by users to form opinions to guide the series of interviews with experts on the topic.

3. EXPERT INTERVIEWS

Expert interviews were conducted to gain insights into persuasion processes in link-enriched video (section 3.2.1) and to broaden the spectrum of types of information that users need to form opinions and make decisions on environmental issues (section 3.2.2).

3.1 Method

Interviewees. Five experts from the audiovisual and environmental governance fields were interviewed, namely: a project manager who works for a broadcaster (interviewee 1, I1); a social communicator who works with environmental risks and disasters in a governmental organization (I2); a researcher and developer of videos and documentaries in a research institute (I3); a project manager who designs environmental education programs in a non-governmental organisation (I4); and an expert who works for environmental and water consultancy in a governmental organisation (I5).

Interview. Two types of semistructured interviews were prepared: one for experts from the field of video production and broadcasting (I1 and I3) and another for environmental governance experts (I2, I4 and I5). The interviews consisted of two types of questions: open questions, to elicit what information users need to form opinions and make decisions and what types of information hypervideo can provide; directed questions, to cause the domain experts to focus on particular types of information that users might need for this task (according to the types mentioned in the related work). The specific questions asked can be found in Appendix 1.

Procedure. The conversations with the interviewees were recorded and notes were taken. In some cases they sent additional information (such as links) by e-mail.

3.2 Results

We summarize below the ideas expressed by the experts, indicating the interviewee number in each case.

3.2.1 Persuasion in link-enriched video

Link-enriched video implies a different way of watching videos, but is not more or less persuasive than other media. Persuasive attributes in link-enriched video can come from the relations that are created between contents (I1). Arguments including the description and reflection on previous impacts related to the issue are highly persuasive, as they indicate there might be a learning experience supporting them (I4). Identification (empathy) of the individual with the speaker giving an opinion is crucial for persuasion. People who value the same things as the user are more likely to influence his or her opinion (I5), as it is stated by the Elaboration Likelihood model (section 2.2). Arguments based on emotions (pathos) have a strong impact. However the impact might only be effective in short-term as users soon tend to forget about this type of message (I5).

3.2.2 Types of information

Users require sufficient and diverse information to have a complete, unpolarized and informed opinion or decision (I4 and I5) (section 2.3).

Description of the problem. An explanation of the physical, chemical and biological components involved in the environmental processes is fundamental to describe environmental quality (e.g. proportion of pollutants or pathogens in the air, water or soil). This should also address the time and space in which the problem takes place (I4) (section 2.3, 'Details about the problem').

Background of the problem. Understanding the background of the issue and what caused it is important. As well as the processes that happened before reaching the current

situation (I2). Valuable lessons can be learned from previous experiences (I2, I4 and I5).

Table 1: Information that could be captured in an annotation schema. The items were selected from literature and/or interviews (I).

Types of information	Sources
Details of the environmental problem	
Basic description: Type - Subject - Location - Date - Physical, chemical and biological processes.	[14] and I4
Impact: scale (individual, local, regional, national, global) - Impact on human communities, health and species	[14], I2, I4 and I5
Temporality: Background of the issue (lessons learned, causes) - Outcomes (short-term) - Future scenarios (long-term)	[14], [3], I1, I2, I4 and I5
Personal implications: Responsibilities - Instruments to take action	I4
People involved: Types of actors - Objectives	[14], [13] and I5
Position/Opinion	
Argument: Direction (favorable, unfavorable, neutral) - Degree - Saliency - Rethorics (Ethos,pathos/intensity, logos) - Temporality - Advantages - Relation to other arguments (opposite, similar) - Dimensions (Scientific, social, cultural, economic, political, ethical, technical, legal, safety and security, historical)	[10], [4], [1], [8], [14], I1, I2, I3, I4 and I5
Public opinion: Stage of attention cycle (saliency) - Distribution - Saliency - Extent of consensus	[10], [7]
Person	
Type of actor - Details (age, name, culture, values, profession and occupation, location, educational background, biography, related organisations and affiliations) - Arguments expressed - Personal benefits	[14], [13], I1, I3 and I4
Sources	
Name - Level of trustworthiness	I2, I3 and I5
Type (Wikipedia - Books, - Magazines - Scientific papers and reports - Newspapers - Documentaries - Videos - TV programs - Websites - Social sites - Radio broadcasts)	

Impacts and outcomes of the problem. Information about the species and communities that are affected by the problem and how the issue may affect the individual's and his/her relatives' health or life is also needed (I5). People need to be able to compare possible future scenarios and calculate by themselves costs and benefits in each case (I4). This requires information about the impact of the issue at international, national and regional levels, including even the specific area where the person lives (I5). As well as data about the population affected, future scenarios must be presented showing potential outcomes. It is important to communicate to people that these scenarios are hypotheses, making clear that they do not present hard facts (I2). Simulations can be highly useful as they show accurate implications, modelling the real world (I5).

Diverse opinions. People should be able to compare cost and benefits of the diverse positions and opinions (I4). Opinions from different actors with different interests and motivations are relevant. Environmental decisions are collectively made (I4). People need to listen to others' opinions when forming their own opinions and determine their position for a decision. This makes information more objective and less biased by partial opinions (I2, I4 and I5) (section 2.3, 'Opinions'). Discussions and debates are also valuable(I5).

Scientists' arguments are only one perspective and they do not represent an absolute truth. Opinions from close people are also highly influential: people care about what the neighbour or the family thinks (I5). An opinion can support, counter or be neutral towards an issue. Opinions have basic arguments and they can be supported or rejected by the receiver (I1) (section 2.3, 'Opinions').

Facts and opinions. The difference between facts and opinions raises epistemological and philosophical discussions. It can be so subtle that it can be difficult to differentiate facts from opinions. An opinion itself can contain different levels of factuality and subjectivity (I1 and I3). These levels can be determined to some extent, for example, by measuring emotion in words (I3). It is the community that determines how factual information is. A fact is what most people believe is truth and generally it is supported by clear scientific statements (I4). Facts tend to be quantitative and are usually related to scientific and technical dimensions. Opinions tend to be qualitative, generally related to political, legal, and ethical perspectives (I1).

Actors. Information about the speaker expressing a position can be relevant for forming opinions: interests and motivations (benefits) of the speaker (I4); level of trust (I3); other opinions or reports on the topic (I1); culture, values, age, hobbies, occupation, location and economic activities (I4); biography (I3); and general background (I1 and I4).

Dimensions. Environmental problems are complex, they have many facets (I4). They can be analysed from the scientific, economic and financial, legal, political, and social perspective. There are also other perspectives that are independent from the later but can also be overlapped, such as the safety and security, the ethical and moral and the historical perspective (I1) (section 2.3, 'Dimensions of analysis').

Sources. People need to have access to diverse information to avoid being biased by certain pieces of information (I2 and I5). Trustworthiness of information and sources linked should be considered by users when forming their opinions and making decisions (I3).

3.2.3 Discussion

Though the number of interviewees could be enlarged in future work, it was possible to identify main ideas from the information experts provided. Literature and experts indicate that environmental video content can be enriched from multiple perspectives in order to be used in opinion-forming and decision-making. All possible information previously elicited was organized in types and subtypes in order to configure a set of data to be used in the convergence stage of the study. The groups of information comprise: details about the environmental problem, description of positions or opinions and other information related to the scene. Table 1 summarizes possible types of information that could be captured in an annotation schema for video to enhance

environmental opinion-forming and decision-making (A diagram showing similarities and differences of the types of information elicited from the literature review and the experts interviews can be found on Appendix 2).

Annotating all these types of information in video content might not be viable and feasible for content providers and broadcasters. A prioritisation is needed. Users are the genuine source of knowledge in this sense. Their ideas, reasoning and behaviour when forming opinions provide insights into their most important information needs.

4. USER SURVEY

We conducted a user survey to assess the relevance of all types of information that could be captured on an annotation schema. Users were asked to reason and reflect about their information needs when forming their opinion or making decisions on environmental issues.

4.1 Methods

4.1.1 Procedure.

The survey was online during 9 days, from May 26th to June 3rd 2012. Answering all the questions was compulsory to finish and submit the survey.

Questionnaire. The questionnaire comprised 19 questions divided in 2 main sections (all the questions can be found on Appendix 3). The first section included general questions to describe the sample and questions to measure important aspects of link-enriched video for users. The second part was based on an environmental case: shale gas drilling. Users had to imagine that there was a project aiming to build a shale gas drilling pad in the region where they live. They were asked to suppose they were informing themselves to decide whether to sign a petition for or a petition against the project. Participants were shown 2 video fragments of people arguing on the topic. One of the videos showed the CEO of an energy company enhancing positive aspects of shale gas extraction and supporting them with facts. The other fragment presented an organic farmer expressing her opinion and emotions towards these procedures. Questions made in this section aimed to rank the relevance of types of information, dimensions, sources and types of actors; to assess the difference between facts and opinions; and to obtain the most important properties of people that should be considered in video annotation.

Measurements. The the types of information available in Table 1 were included in the survey in order to assess their relevance.

For most of the questions Likert scales of 5 items were used. Participant's answers could vary from 1 to 5 in order to capture the intensity of their responses. A neutral option was always included. In other cases, users were asked to rank variables using a drag and drop function (options were randomly ordered to reduce bias). Text fields for comments and open questions were included.

Participants. 316 participants participated in the survey. Data from 103 users were removed because they had not filled in the complete survey, and we assume they might have not answered properly if not committed to finish it. After removing these participants, data from 213 participants remained in our data set.

A self-selective sample was drawn. Respondents varied in age, gender, country of residence, level of education and frequency of time spent watching TV, online videos and reading the newspaper. The sample consisted of 124 (58%) women and 89 (42%) men. Respondents were from 27 different countries. The participants in the sample were relatively young (M = 25.2, SD = 8.2). The youngest respondent was 16 years old and the oldest, 81 (Fig. 1). The sample was well educated; for almost 54% of the respondents the higher education (Bachelor) is the highest accomplished level, followed by the postgraduate level (22%), secondary education (23%) and primary education (1%).

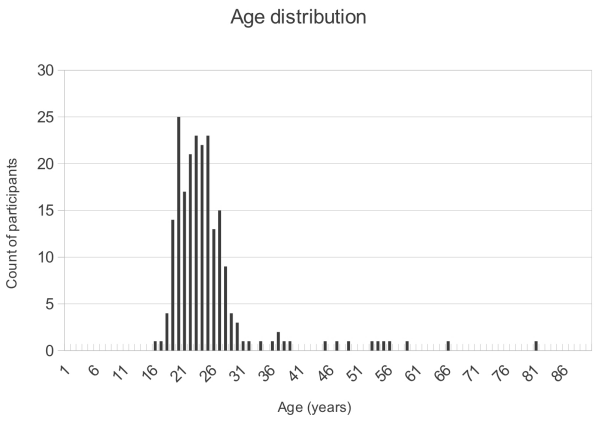


Figure 1: Age distribution

4.2 Results and discussion

4.2.1 Relevance of types of information

Results state that the most useful type is factual information (M = 4.6, SD = 0.6). Users are interested in considering diverse opinions (M = 4.3, SD = 0.7) and discussions and debates (M = 4.1, SD = 0.8).

Opinions from people who think similarly, the dominance and saliency (or intensity) of the public opinion and emotional arguments were considered less useful (Fig.2).

Users ranked their interest on different details about problems by assigning to each one a position out of 9 in the ranking. A basic description and impacts on health were the most important (Fig.3).

As regards the different dimensions, users' responses state that the most relevant dimensions are the scientific and technical (M = 4.4, SD = 0.7), the safety and security affairs (M = 4.3, SD = 0.7) and the social and cultural dimension (M = 4.2, SD = 0.7) (Fig. 4 and Table 2).

As regards the source of the video, users claimed that knowing the publisher or broadcaster was relatively relevant for them (M = 3.8, SD = 1.0), in particular to determine the validity of the arguments or the expertise of the speaker.

4.2.2 Information to be captured about people

Users' responses indicate that the way a speaker might benefit from the position s/he holds (M = 4.5, SD = 0.7), the organisations to which s/he belongs (M = 4.5, SD = 0.7) and her/his profession and occupation (M = 4.3, SD = 0.7) are the most relevant aspects to consider when deciding whether to believe him/her or not. Users also consider

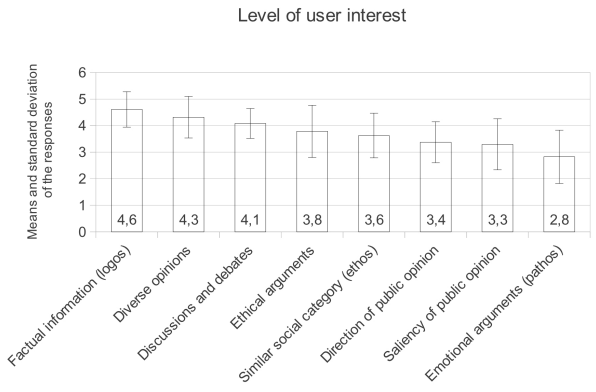


Figure 2: Interest in types of information when forming opinions.

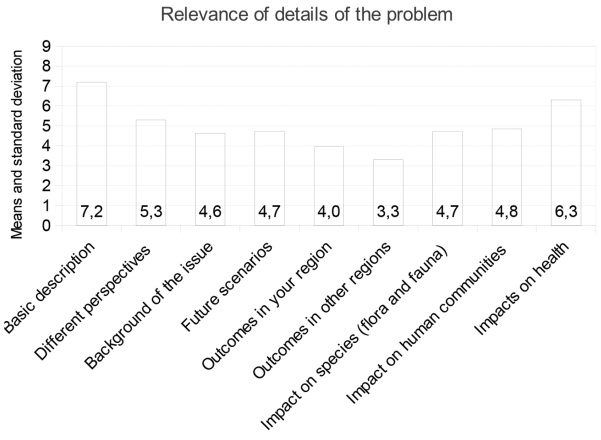


Figure 3: Types of information organized in order of relevance from the left to the right (higher means represent more relevance).

Figure 4: Level of relevance of the dimensions of an issue.

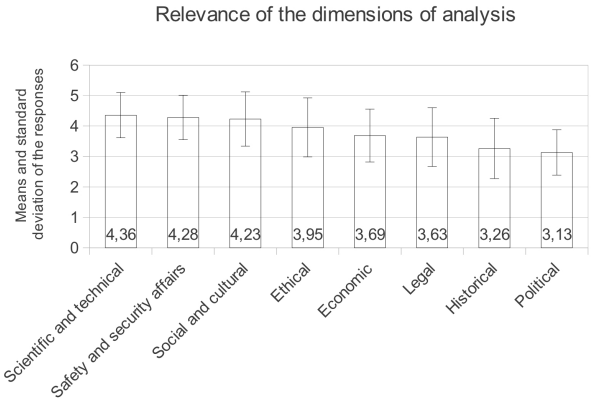
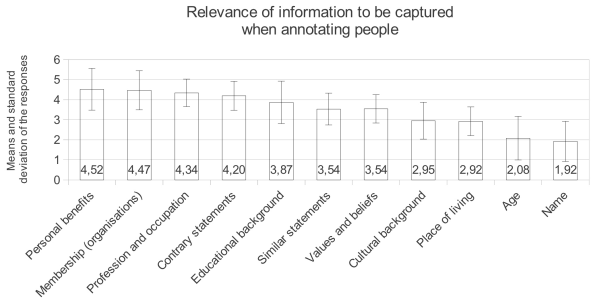


Table 2: Level of relevance of the dimensions of an issue: percentages of responses for the "relevant" and "very relevant" items of the scale.

Dimension	Relevant	Very relevant
Scientific and technical	40%	48%
Safety and security	45%	43%
Social and cultural	49%	37%
Ethical	51%	25%
Economic	49%	14%
Legal	44%	17%
Historical	31%	10%
Political	32%	7%

Figure 5: Responses for each type of information that could be annotated for a person.



highly relevant to listen to other arguments expressed by a speaker, only when they are opposite (M = 4.2, SD =0.7). Contrary opinions are more relevant for them than similar opinions (M = 3.5, SD = 0.9) (Fig.5).

Users also mentioned the relevance of considering: the level of truth in the facts the speaker expresses (using peer-reviewed information), the body (non-verbal) language used while speaking, positions held by other people, whether s/he is answering the questions made by the interviewer or s/he is avoiding them, and what other people of the same status and educational level think.

4.2.3 Difference between facts and opinions

Whereas around 90% of the respondents agreed that identifying whether a statement is a fact or an opinion is important (M = 4.3, SD = 0.7), only 73% stated that it is possible to differentiate them in a discourse (M = 3.8 , SD = 0.8).

70% of the participants stated that the first video fragment presented a blend of facts and opinions; half of the rest claimed the position of the speaker was based on facts and the other half stated that it was an opinion. 78% of the sample classified the second video fragment as an opinion; 20% claimed it was a blend of facts and opinions and only 2% stated that it was based on facts.

When being asked about how useful they found the video fragments shown, no significant difference was made. Both fragments were equally useful for users (M = 3.2, SD = 1.0).

Even though users claimed that factual information is more relevant than emotional and ethical arguments, when being asked about the usefulness of each video fragment no difference was made. There is a contradiction between what they claimed that is relevant and the level of usefulness assigned to the video segments they watched.

Figure 6: Results of the ranking of relevant sources.

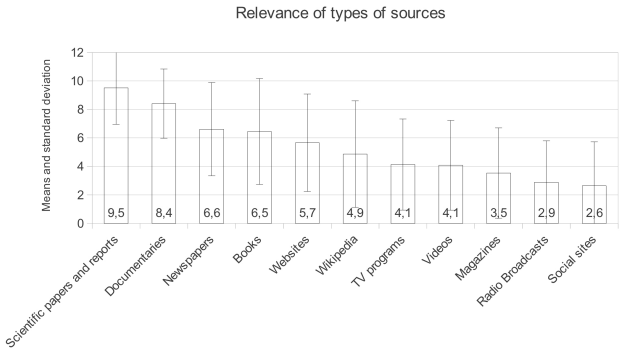
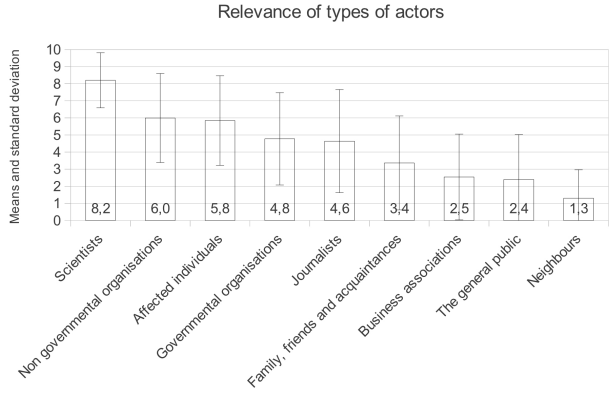


Figure 7: Results of the ranking of relevant actors.



4.2.4 *Sources of information and types of actors*

Users ranked only the sources they considered relevant by assigning them a position out of 11. Their responses indicate that the 3 most useful sources of information are: scientific papers and reports (M = 9.5, SD = 2.6), documentaries (M = 8.4, SD = 2.4); and newspapers (M = 6.6, SD = 3.2) (Fig. 6).

As regards types of actors, they ranked only the ones they considered relevant in a ranking of 9 positions: scientists' opinions (M = 8.2, SD = 1.6), non governmental organisations' positions (M = 6, SD = 2.6) and affected individual's testimonies (M = 5.8, SD = 2.6)obtained the higher scores (Fig. 7).

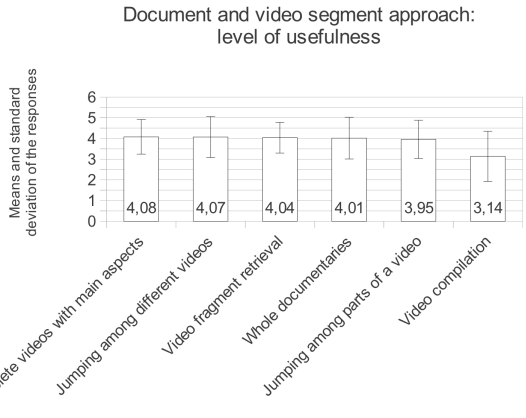
4.2.5 *Information needs expressed in open questions*

Open questions were analysed qualitatively. We read answers and then a word cloud was generated to analyse the relevance of the needs identified (Fig. 9). The graph was used as a visual tool for the qualitative analysis of the responses (stop words and domain specific words -i.e. Shale gas extraction- were removed).

The most frequent need expressed was to have access to evidence, facts, objective and unbiased information, exact data and results from research. Opinions from "independent" people (not affiliated or part of a company) holding a "neutral" and "honest" position were highlighted.

Users prefer complete information over pieces of information. They want benefits and disadvantages, pros and cons

Figure 8: Results of the ranking of relevant actors.



of the issue, costs and benefits integrated in one video. Risks involved and other aspects related to the safety, security and health implications were mentioned by many participants. As well as consequences and outcomes in short and long term. Some of the results in the survey indicated that users find more relevant the scientific and technical perspective than the security and safety perspective, whereas in open questions users' expressed with more emphasis their interest in the latter.

A frequent information need is to know about possible alternatives, what other possibilities or techniques can be useful to achieve the same goals. Users want to compare benefits and disadvantages of each alternative to choose the best cost-benefit balance. They are also interested in knowing about the level of community need for the benefits of the phenomenon under discussion.

Several participants mentioned the need to know who benefits, who is making money out of it, which types of actors support these initiatives and who are against.

4.2.6 *Document and video fragment approach*

For the majority of users all possibilities offered either by a document or video segment approach are useful or highly useful (Fig. 8). Compiling or generating own videos by combining different segments was the least useful (M = 3.1, SD = 1.2). This suggests that automatic video generation seems more attractive.

The function that obtained the highest level of usefulness is to watch complete videos including all the main aspects of the problems (M = 4.1, SD = 0.7); and in the second place, to jump from one video to another (M = 4.1 , SD = 0.9).

4.3 Limitations of the user survey

There are several noteworthy limitations of the sample in this study, due to issues related to self-selection bias. The sample was not randomly drawn, which may have produced effects in the results. Besides, the relatively high educational level of the sample may also have produced effects on the mean of the responses of each item. Cultural differences were not considered in this study. Most of the participants were Dutch, and the data obtained from people of other countries was not enough to draw conclusions in terms of culture.

Figure 9: Word cloud representing the frequency of words mentioned in the open fields.

5. USER EXPERIMENT

To assess the usefulness and the level of priority of the types of information while forming opinions and making decisions, we observed the way users perform information seeking and exchange tasks on a specific environmental issue. We compare these results with those obtained in the user survey.

5.1 Method

Participants. 4 of the 6 users had already filled in the survey. 5 of the 6 participants were female. The youngest was 16 years old and the oldest was 25. 2 were Dutch, and the others were from Romania, Cyprus, Germany, and the United States.

Measurements. We selected 25 video fragments about shale gas drilling. The segments had a duration of around 1 or 2 minutes. Each of them represented a type of information identified in the divergence phase. All the different types of actors, dimensions of analysis and directions of opinions were represented by one video segment. Users had to decide which type of information they wanted to access based on the title of each video fragment.

Procedure. Users watched a short video fragment introducing the shale gas drilling issue and were then asked to imagine that they had to decide whether to sign a petition for or against shale gas extraction in their region. To inform themselves, they had to choose 3 video fragments out of 25. Before and after watching each selected video fragment they were asked about their expectations and the reasons for their choices. After each segment, they were given 3 minutes to consult online resources. They had to decide whether they agreed with or believed the ideas expressed in the fragments depicting a single speaker's or organisation's opinion; or they had to check any other additional information need triggered by the segment. Finally users were asked to rank and explain the usefulness of the sources they used. At the end, they had the opportunity to mention other information they would like to review and other fragments they would also have wanted to watch.

5.2 Results and discussion

5.2.1 Document and video fragment approach

Most of the participants expressed that the video fragments were too short to enable them to be informed. In many cases they expected more information than they obtained. Even though they had been shown a brief introduction to the topic, most of them expressed they would have preferred to watch a video with an overview. This overview should include objective information covering the most important variables of the problem, different perspectives, and both supporting and non-supporting opinions. Participant 2 (P2) in particular expressed the need to put together several types of information at the same time to choose a fragment. S/he was particularly interested in combining the direction of the arguments (the arguments against) with the scientific dimension.

5.2.2 Users' motivations and information needs

Three participants (P1, P5 and P6) decided to watch the "Arguments supporting shale gas drilling". Other fragments were chosen by two participants: "Affectation of human communities" (P1, P3), "Arguments against shale gas drilling" (P4, P5), "Potential outcomes" (P4, P6), "Diverse opinions" (P2, P6), "Health implications" (P3, P5). Users chose to access the video fragments using a dimension of analysis in 4 cases, the direction of the opinion in 5 cases and using other categories in 9 cases. None of the participants chose a fragment titled by the type of actor giving arguments (a detailed summary of the results can be found in Appendix 4.2). The most frequently expressed needs were safety, security and health implications, outcomes and future scenarios.

Words and phrases such as "impacts", "effects", "risks" "disadvantages" and "health implications" were used in users" queries. When searching for information online after watching each segment, some participants found difficulties in specifying terms for their queries. This suggests that keywords mentioned in the video should be also available in written text for users. One participant expressed her/his desire to access an explanation in "easy words". 3 participants were interested in checking alternatives to shale gas drilling or solutions implying less negative impacts for human beings (P2, P3, P6).

The need to consider opinions from people that are more neutral, objective or that do not have particular interests or benefits on the issue was highlighted.

Even though most of the participants stated their intention to be informed from many points of view, they tended to choose all the segments following one topic or direction. 5 participants decided to be against shale gas drilling almost from the beginning of the experiment (P4 was the exception). Surprisingly, when a fragment contained supporting arguments they considered them as less useful and biased. This confirms what persuasion theories state: users tend to give more weight to arguments that support their own opinion (section 2.2).

Two participants (P3 and P4) had chosen 3 fragments in advance and later decided to switch them. This could indicate that information needs evolve while forming an opinion and are renewed each time new information is processed.

5.2.3 Sources of information and types of actors

All participants used the Google search engine. 3 out 6 accessed Wikipedia. 2 scanned Google results lists to get informed (they did not open any result). 1 participant accessed Google Scholar (P2). 1 used YouTube (P5). Other sources used were news sites (The Guardian, News24.com, and BBC) and other web sites specialized in the topic.

The use of Wikipedia in the experiment suggests its relevance, even though in the survey it was ranked in the 6th

position out of 9. Users did not always pay attention to the name of the source or its credibility. Many of the sources they opened were not familiar to them. Only one participant reflected on the importance of the trustworthiness of the source (P2). Participant 3 considered whether the site contents were reviewed by experts or not to rank them. In many cases users scanned scientific papers and reports related to the topic.

None of the participants chose to access a video fragment representing the opinion of a particular actor. Even though in several occasions they mentioned they wanted to listen to an expert, they did not choose the fragment labelled "Dr. Ingraffea (professor on fracture mechanics)". To determine whether to believe a speaker or not, users searched for concepts mentioned by the speaker. A participant (P4) expressed s/he wanted to know the name of the speaker to look for information about his background.

5.3 Limitations of the experiment

Only 6 people participated in the experiment, which limits the generalisability of the results. As none of the participants was specially interested in the topic, we cannot ensure that the levels of elaboration varied. This could influence the results as most of the users might have been persuaded through peripheral routes and needs triggered from central route processing might be absent (section 2.2).

The topic chosen and the age of the participants can also influence the resulting levels of relevance of information. It is possible that certain aspects of information are more or less relevant according to the type of environmental issue and the characteristics of individuals.

Finally, there is a risk that the title chosen for each fragment did not convey the type of information we aimed to represent. For instance scientists' opinions were represented by the fragment of the professor on fracture mechanics. Participants might not have chosen it in spite of their intention to listen to a scientist, because this expert was specialized on fracture mechanics

6. CONCLUSION

6.1 Information that should be captured in video annotation

From the broad spectrum of information that could be captured in video annotation (sections 2 and 3, Table 1) we identified the most meaningful types for users (sections 4 and 5). Table 3 lists the selection of the most relevant types of information, which should be considered in video annotation in the environmental domain.

Table 3: Information that should be captured in an annotation schema, according to the results of the user survey and user experiment.

Details of the environmental problem	
Basic description	Type - Subject and relation to other subjects (alternatives) - Location - Date - Physical, chemical and biological processes.
Impact	Impact on human communities (emphasis on health).
Temporality	Outcomes (short-term) - Future scenarios (long-term).
People involved	Types of actors - Objectives.
Position/Opinion	
Argument	Direction (favorable, unfavorable, neutral). Rethorics (pathos/intensity, logos). Temporality - Advantages - Relation to other arguments (opposite, similar). Dimensions (Scientific, technical, safety and security).
Person	
Details	Name, profession and occupation, educational background, related organisations and affiliations.
Arguments	Arguments expressed - Personal benefits.
Sources	
Basic	Name - Level of trustworthiness.
Type	Scientific papers and reports - News - Documentaries - Wikipedia.

6.1.1 *Details of the environmental problem.*

Users prefer a document approach over the search and retrieval of short video segments. Even though they want to have the possibility to jump to related videos, they need clips that integrate perspectives about the issue (sections 4.2.6 and 5.2.1).

Users need an overview of the issues, which should contain: the location and date, the main processes involved, the advantages and disadvantages of these processes, the level of community need for the resulting benefits of the phenomenon under discussion and possible alternatives to replace the benefits and avoid it (sections 4.2.1 and 5.2.1). This suggests the need for an automatic video generation approach. To enable the generation of videos with details of issues, an annotation schema should capture the subject, direction of arguments, level of objectivity and subjectivity (section 6.1.3), and also relations between the main topic or subject with other topics.

Users are concerned about outcomes and future scenarios. They care about how human communities can be affected and particularly human health (sections 4.2.3, 4.2.5, 5.2.2). Video annotation should consider the temporality of the arguments, and capture particular arguments about the future.

6.1.2 *Dimensions.*

The safety, security and health implications of an environmental issue are fundamental. Users are highly interested in the scientific and technical perspective of issues (sections 4.2.1, 4.2.5, 5.2.2). An annotation schema should capture the dimension/s from which a problem is analysed.

6.1.3 *Facts and opinions.*

Factual information is the most useful according to users (sections 4.2.1, 4.2.3, 4.2.5, 5.2.2). An annotation schema should capture the level of subjectivity (pathos) and objectivity (logos) identified in a discourse.

Annotation should capture the direction of opinions (favourable, neutral or unfavourable) and the relation between them (opposite or similar) (sections 4.2.1, 4.2.5, 5.2.2).

6.1.4 *Information to be annotated about people.*

Users care about how the speakers benefit from the position they hold, the organisations and affiliations s/he be-

longs to, his/her name, profession and occupation (sections 4.2.2, 5.2.3). Links to different arguments expressed by a speaker and also the relation between those arguments (whether they are opposite or similar) should be captured (section 4.2.3).

6.1.5 Sources and links to external sources.

The name and the level of trustworthiness of sources should be captured in video annotation. Users prefer experts' and scientists' explanations, which are consider more objective sources of information (sections 5.2.3,5.2.3).

The most relevant types of sources to enrich video content are scientific papers and reports, documentaries and newspapers. Apart from links to generic sources, domain-specific websites could also be considered in video enrichment.

6.2 Future work

The level of relevance of types of information might differ under certain conditions not considered in this study. Further work should determine: if information needs change in the process of getting informed, and in case they do, how they change; whether different levels of education and cultures imply differences in information needs; if there are differences in the needs for processes of opinion-forming and opinion-change; and how the information requirements differ according to the level of elaboration.

The next step in the research would be to annotate a selection of videos with the information types given in Table 3 and use these for creating an environment with linked videos.

Instead of making users reflect about possible functionalities, future experiments should analyse them when interacting with link-enriched video applications.

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Appendices

Appendix 1: Expert interviews

1.1 Experts in fields related to video

Link-enriched video possibilities.

1. Different researchers on information studies, computer science and human computer interaction claim that link-enriched video technology provides novel possibilities for users. Could you mention some of these possibilities?

    1.1 What new information related possibilities does it offer?

2. Has the potential of this technology been already exploited? Do you know relevant initiatives using hypervideo? Which (novel) users' information requirements can they meet?

3. Does link-enriched video have the capacity to influence beliefs, attitudes, or behaviors? Does this technology have particular persuasive capacities?

Link-enriched video possibilities for opinion-forming and decision-making on environmental issues.

4. Which of the possibilities offered by link-enriched video could support users when their goal is to form an opinion or make a decision on an environmental issue? i.e. whether to sign or not a petition against a paper mill.

5. Imagine an experiment on which two groups of users are asked to form an opinion or make a decision on an environmental issue. The group A uses a link-enriched video application to browse video content. The group B uses a common video search engine, on which videos are not linked nor enriched. What could be the results?

    5.1 Would it be easier/better for group A or B to achieve the task? What would be the differences between the processes made by each group?

Video annotation.

6. In general, what should be annotated in any video? Would this differ according to the domain of interest?

7. How should videos be enriched for an application that aims to help users to form their environmental opinions and decisions?

    7.1 What should be particularly captured from videos and/or fragments addressing environmental issues in order to be useful for users willing to form an opinion or make a decision about an issue? Could you provide at least 5 aspects in hierarchical order of importance?

    7.2 Which aspects of the audiovisual content would be relevant for users performing such a task?

7.3 Do you imagine specific types of information that should be specified?

8. Do you believe that providing different points of views or perspectives about a problem can help users to make better (more sustainable) environmental decisions and opinions?

8.1 If yes: What characteristics of opinions could be annotated? Could you provide 5 aspects in hierarchical order of importance? What are the relationships that should be established among the different opinions?

9. Often in environmental videos different actors give statements, testimonies and opinions. Would it be useful for users to have access to information or characteristics about the speaker? If yes: what type of characteristics?

10. Do you know any developed model, similar example or annotation schema that could be useful for an application forming users' opinions and decisions on environmental issues?

11. How would you tell the difference between a fact and an opinion in video content?

11.1 What characteristics of opinions could be annotated? What characteristics of the facts could be annotated?

12. At what level of granularity it would be convenient to annotate video content?

12.1 Would it be better to annotate it for fragments or for the complete video?

12.2 For fragment-based annotation: How could videos be segmented? What should be considered a "fragment"? Is it important to provide the context (time and space) on which a particular content takes place?

1.2 Experts in fields related to environmental governance

Types of information needed for environmental opinion-forming and decision-making.

1. What type of information is relevant for individuals to make sustainable opinions and decisions on environmental issues?

1.1 Do people tend to be more concerned with an environmental problem when they feel the problem can affect them directly?

1.2 How important is to determine the groups, species or communities that are more vulnerable or endangered due to an environmental problem?

1.3 Is it useful to communicate the potential consequences or outcomes that the issue can have?

1.4 Is it useful to present the current state of the situation and provide different scenarios of what could happen?

1.5 Is it important to show the perspectives of the different actors involved?

1.6 Is it important for people to know if an opinion or policy was originated from the government, from business associations or the community for instance?

2. What can influence more an individual's opinion or decision? What can persuade people when it comes to environmental issues?

3. What strategies or techniques are useful when informing or educating people about environmental problems, potential consequences, policies, etc.?

4. Can the particular characteristics of each individual (level of education, ideology, for instance) determine the type of information s/he needs to make environmental decisions? Are certain types of information or perspectives on a topic more or less suitable for particular individuals?

Audiovisual media for opinion-forming and decision-making.

5. Do you believe that videos can be used to enhance or reduce awareness on environmental problems? Why?

6. Do you remember any experience on which environmental videos were shown to individuals with educational or informational purposes?

6.1 If yes, how was the experience? Did the individuals involved change their minds about the problem? Did they ask questions in the process? Do you remember any of those questions?

7. Can other media be used to enrich processes of creation of environmental concern and awareness? If yes: Which and how is it used?

8. Are there any relevant or interesting videos in this field that you would recommend?

9. Link-enriched video technology enables to link video content (fragments or whole videos) with other video contents and other type of media (such as images, audio, web sites, etc.). In this framework, users can retrieve video content about environmental issues in a novel way. A user watching a BBC documentary reporting the effects of climate change in Switzerland could for instance jump to a technical video explaining the greenhouse effect . Or s/he could also choose to watch news reporting a popular strike against a modification in the regulation policies regards the conservation and use of forest resources. Do you imagine any information that this technology can provide to form peoples' environmental opinions?

9.1 What types of connections between videos or fragments of videos could be useful for people forming environmental opinions?

9.2. Do you believe that providing different points of views or perspectives about a problem can help users to make better environmental opinions and decisions?

9.3. Would it be useful for individuals to be able to decide the direction of the opinions they want to watch?

9.4 Would it be useful to enable them to choose the type of actor that they want to listen to (government representative, scientist, neighbour, etc.)?

9.5 Would it be relevant for people to be able to watch different consequences or future scenarios that different human actions can influence?

9.6 How could these consequences be classified?

9.7 Would it be relevant for them to watch testimonies or documentaries presenting lessons learned or the evolution of a problem over the years?

9.8 What dimensions of an environmental problem should be presented? (for instance the economic aspects, the political ones)

9.10 Can it be positive for decision-making processes to be able to search and access specific fragments of videos according to the need?

Annotation resources.

10. Do you know any initiative particularly dealing with digital data about the environment?

12. Do you know any taxonomy, or other form of knowledge organization system, particularly referred to the environment?

Appendix 2: Types of information elicited in the literature review and expert interviews

Figure 1 summarizes the findings from the literature review and the expert interviews.

Appendix 3: User survey

3.1 Content of the survey

Introduction.

Dear participant,

Thank you in advance for participating in this study about link-enriched video for opinion-forming and decision-making on environmental issues. I am conducting this survey as part of my Master's Thesis in Information Studies, at the University of Amsterdam.

For some questions, short video fragments will be shown to you. These fragments are taken out of context and thus do not necessarily represent the opinions of the speakers. This survey was designed with academic goals and it does not aim to promote particular judgements or ideas on shale gas drilling.

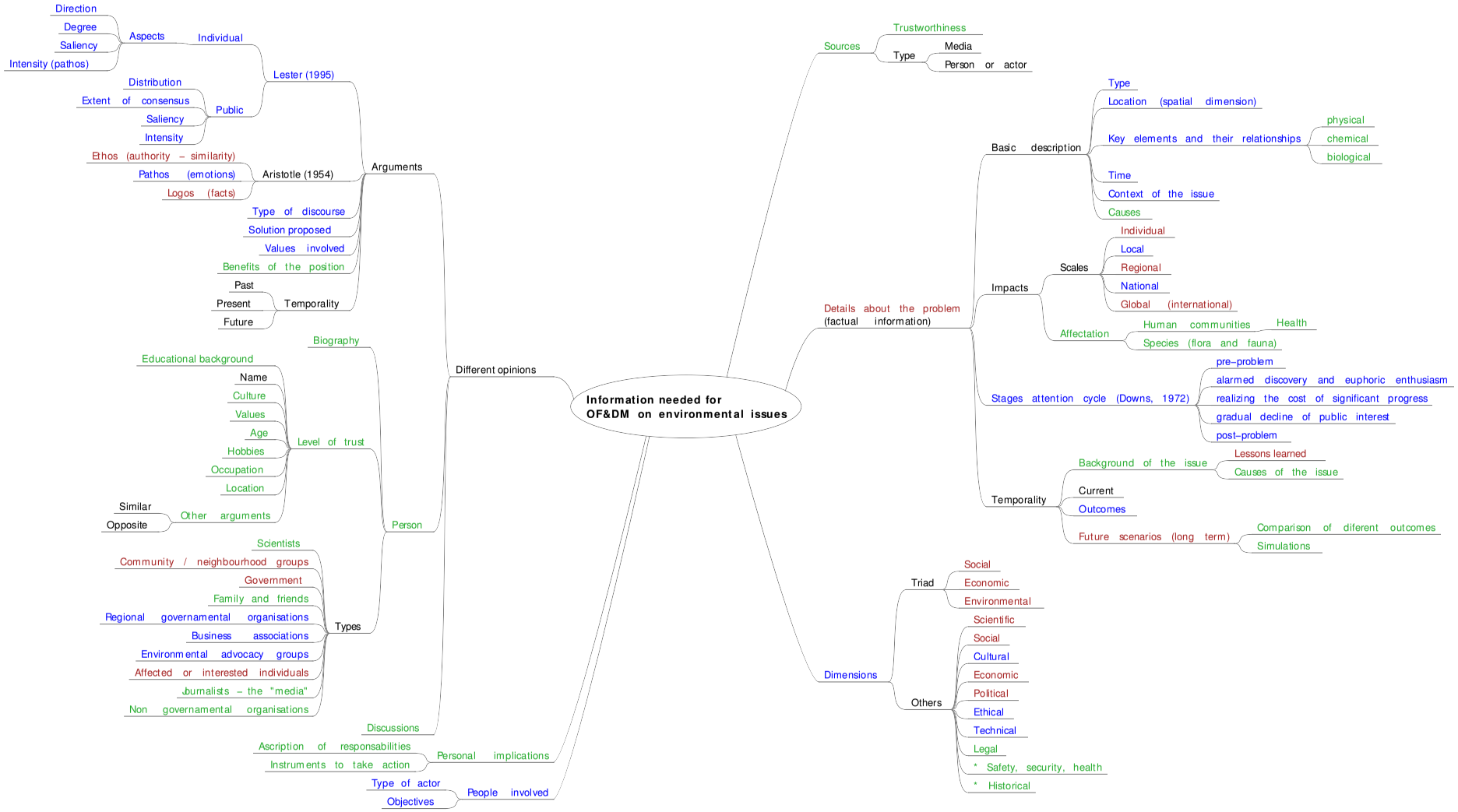

Figure 1. Mind map of the types of information needed for OF&DM on environmental issues. The green items were mentioned only by experts and the blue ones were only present in the literature. The red items were mentioned in both whereas the black ones were introduced to organize the findings in groups.

This is an anonymous survey. No personal data are collected.

The survey comprises 20 questions separated in 3 sections. Answering all the questions will take about 10 minutes. An option to save your answers and continue later is not available. Please do not close the window of your browser until you submit your answers. Unfortunately, some questions cannot be answered using mobile devices, so if you are using a mobile device or tablet, please fill in the survey later using a desktop or laptop computer.

Thank you very much for your attention, and for supporting my Master's Thesis work.

Ana Carina Palumbo

1. During the last 10 years, where have you lived most of the time?
2. What is your gender?
3. What is the highest level of education you have achieved?
4. Indicate the frequency for each activity.

    a. How often do you watch TV?
    b. How often do you watch online videos?
    c. How often do you read newspapers?
    Possible answers: Never - Rarely (at least once a month) - Occasionally (at least once a week) - Frequently (at least once a day) - Very frequently (more than once a day)

5. Imagine that you are interested in informing yourself to form an opinion on a particular topic. You want to watch video content about it. Indicate how useful you would find:

    a. To watch whole documentaries
    b. To be able to easily find parts that you are interested in from a whole video
    c. To watch complete videos including all the main aspects of the problems
    d. To be able to jump from one part of the video to another part of the video
    e. To be able to jump from one part of a video to another related video
    f. To be able to easily create your own video compilation, combining relevant fragments of different videos
    Possible answers: Very useless - Useless - Neutral - Useful - Very Useful

6. Imagine there is an environmental issue that is currently under debate. You want to form an opinion about this issue and you also want to decide whether to support or to be against related initiatives. Please indicate the level of interest that you would have in considering the following:

a. Diverse opinions about the matter

b. Discussions and debates among people with different opinions

c. Factual information

d. Emotional arguments

e. Ethical arguments

f. Opinions from people that think similarly to the way you do

g. The dominant opinion of the general public

h. The level of public attention to the issue

Possible answers: Not interested at all - Not interested - Neutral - Interested - Very interested

7. Indicate to what extent you agree with the following statements:

a. Facts and opinions can be differentiated in a discourse.

b. Identifying whether a statement is a fact or an opinion is important when forming your own opinion.

Possible answers: Strongly disagree - Disagree - Neutral - Agree - Strongly agree

Shale gas drilling: part 1. The questions below are related to shale gas drilling. You do not need to know about the topic to answer them and it is not necessary to consult additional resources while filling in this survey.

Imagine that there is a project aiming to build a shale gas drilling pad in the region where you live. The initiative generates a debate. There is a petition against building the drilling pad and a petition to support building it. Therefore, you want to inform yourself to decide which one to sign.

8. What information would you need to inform yourself about shale gas drilling in order to make your decision on which petition to sign? Please rank the following items based on their relevance to inform yourself and make your decision. Drag the items from the left and drop them in the right area.

a. Outcomes in other regions

b. How the issue could affect humans' health

c. Future scenarios (read note 4)

d. Outcomes in your region

e. Different perspectives of the issue (read note 2)

f. Human communities that could be affected

g. Species (flora and fauna) that could be affected

h. How the problem arose (read note 3)

i. Basic description of the issue (read note 1)

j. You can add additional information that you find relevant

Notes:

1. For instance that it is related to energy production and distribution, which are the physical, chemical and biological processes that it involves, and the specific location.

2. E.g. reflections from the scientific, technical, economic, legal, political and ethical perspectives of shale gas drilling.

3. Previous processes that explain how shale gas drilling could become a problem in the region.

4. Scenarios showing potential consequences of building the pad and consequences of not building it.

9. Indicate the relevance of each of the following perspectives to form your opinion:

a. Scientific and technical

b. Social and cultural

c. Economic

d. Political

e. Ethical

f. Legal

g. Historical

h. Safety and security affairs

Possible answers: Very irrelevant - Irrelevant - Neutral - Relevant - Very relevant

Please play and watch the following video. It shows fragments of an interview addressing shale gas drilling. Pay attention to the answers the interviewee gives.

10. Select the statement that you most agree with.

a. The interviewee mainly describe facts.

b. The interviewee mainly expresses his personal opinion.

c. The interviewee's arguments are a blend of facts and opinion.

11. How useful do you find the interviewee's perspective to inform yourself and form your own opinion?

Very useless - Useless - Neutral - Useful - Very useful

12. In order to determine whether to believe him or not, indicate the relevance of the following information:

a. His name

b. His age

c. His profession and occupation

d. To which organisations does he belong

e. The location where he lives

f. His educational background

g. How he might benefit from the arguments he supports

h. Similar statements expressed by him in other videos

i. Contrary statements expressed by him in other videos

j. His cultural background

k. His values and beliefs

l. The publisher/broadcaster of the video

You can add additional information you would need to determine whether to believe him or not

Possible answers: Very irrelevant - Irrelevant - Neutral - Relevant - Very relevant

Shale gas drilling: part 2.

Video 2

Please play and watch the following video. It shows an organic farmer that lives in the area where the Marcellus Shale is located, in eastern North America. She talks about contamination that could be caused by fracturing operations during shale gas drilling processes.

13. Select the statement that you most agree with.

a. The farmer describes facts.

b. The farmer expresses her personal opinion.

c. The farmer's arguments are a blend of facts and opinion.

14. How useful do you find the farmer's perspective to inform yourself and form your own opinion?

Very useless - Useless - Neutral - Useful - Very useful

15. Now that you have seen 2 videos expressing different opinions about shale gas drilling: What questions are you asking yourself about this issue? Please mention at least two.

16. What additional information would you need to check to make an informed opinion about shale gas drilling? This question is not mandatory

17. What other sources of information would you consider useful to form your opinion about shale gas drilling? Please organise them in order of relevance by dragging them from the left area to the right area. You do not need to drag the items that you do not consider relevant

Books

Documentaries

Magazines

Newspapers

Radio broadcasts
Scientific papers and reports
Social sites (social networks, blogs)
TV programs
Videos
Websites
Wikipedia

18. Whose opinions would you consider useful to inform yourself on shale gas drilling? Please organise them in order of relevance by dragging them from the left area to the right area. You do not need to drag the items that you do not consider relevant.

Affected individuals
Business associations
Family, friends and acquaintances
Governmental organisations
Journalists
Neighbours
Non governmental organisations
Scientists
The general public

3.2 Summary of questions and types of information included in the survey. Table 1 summarizes the contents of questions in the survey and the types of information evaluated.

Appendix 4: User experiment

4.1 Types of information included

Table 2 present the types of information included in the user experiment and the titles of the video fragments representing them.

4.2 Summary of the results

Tables 3 and 4 summarize the results obtained in the user experiment. The tables include the selected fragments and the motivations and expectations expressed by the users before and after watching them. The queries made in each case are also included.

Types of information	**Items in survey**	**Scale**	**Question**
Diversity of opinions	Diverse opinions about the matter	Interest (1 to 5)	7a
Discussion	Discussions and debates	Interest (1 to 5)	7b
Logos (factual data)	Factual information	Interest (1 to 5)	7c
Pathos	Emotional information	Interest (1 to 5)	7d
Values involved	Ethical arguments	Interest (1 to 5)	7e
Ethos	Opinions from people that think similarly	Interest (1 to 5)	7f
Public opinion: distribution and extent of consensus	The dominant opinion of the general public	Interest (1 to 5)	7g
Public opinion: saliency and intensity	The level of public attention to the issue	Interest (1 to 5)	7h
Facts and opinions	Factual / emotional information - Content of video 1 and 2 (facts, opinion or blend) - Usefulness of video 1 and 2.	Interest / Agreement / Usefulness (1 to 5)	7c, 7d, 11, 12, 15, 15
Difference between facts and opinions	Facts and opinions can be differentiated in a discourse - Identifying whether a statement is a fact or an opinion is important when forming an opinion.	Agreement (1 to 5)	8a
Details about the problem	Outcomes in other regions - How the issue could affect humans' health - Future scenarios - Outcomes in your region - Different perspectives of the issue - Human communities that could be affected -Species (flora and fauna) that could be affected - How the problem arose - Basic description of the issue	Rank according to level of relevance (1 to 9)	9
Dimensions	Scientific and technical - Social and cultural - Economic - Political - Ethical - Legal - Historical - Safety and security affairs - Health		10 9b
Properties of person, properties of a person's arguments and level of trust	Age -Profession and occupation - To which organisations does he belong - The location where he lives - His educational background - How he might benefit from the arguments he supports - Similar statements - Opposite statements - Cultural background - Values and beliefs	Relevance (1 to 5)	13
Sources (type of media and trustworthiness)	The publisher/broadcaster of the video - Books - Documentaries- Magazines - Newspapers- Radio broadcasts- Scientific papers and reports -Social sites (social networks, blogs) - TV programs - Videos - Websites - Wikipedia	Relevance Rank according to level of relevance (1 to 11)	13m 18
Sources (trustworthiness of actors)	Affected individuals - Business associations - Family, friends and acquaintances - Governmental organisations - Journalists - Neighbours - Non governmental organisations - Scientists - The general public	Rank according to level of usefulness (1 to 9)	19

Table 1: Types of information whose relevance was assessed in the survey.

Variables	Title
Access by actors	
Affected individuals	Affected resident
Business associations	Chairman EBN (Energie Beheer Netherlands)
Government	Authority in the Bradford County
Reporters and journalists	Reporter
Neighbours	Farmer that lives on one area where shale gas is drilled
Non government organisations	Representative of environmental organization
Scientists	Dr. Ingraffea (professor on fracture mechanics)
Public opinion	Massive protest
Access by dimension	
Scientific and technical	Scientifical and technical: the gas extraction technique
Social and cultural	Culture and heritage impacts
Economic	Economic impacts of shale gas drilling
Political	Political perspective
Legal	New oil and gas regulation
Historical	History of natural gas
Safety and security	Dangers of natural gas extraction
Health	Health implications
Access by direction	
For	Arguments supporting shale gas drilling
Against	Arguments against shale gas drilling
Other categories	
Outcomes	Potential outcomes
Future scenarios	The future of energy
Basic description of the issue	Basic description of the issue
Background of the issue	Why drilling technology started to be used
Affectation on species	Impacts on species
Affectation of human communities	Affected cities
Diverse opinions	Diverse opinions

Table 2: Types of information and titles of the videos fragments representing them in the experiment.

Partic.	Selected types of information	Motivations or reasons for choosing the fragment	Expressed information needs	Queries made after watching the fragment
1	Affectation of human communities	Importance of how people can be affected.	General overview of the possible damages. Pollution it can cause.	No queries were made (the participant expressed that the information on the video fragment was clear and enough).
	Basic description of the issue	To avoid only one perspective of the issue; understand the problem from several points of views (safety is not the only possible point of analysis).	The participant asked to listen to part of a video (about water contamination) twice. More detailed information on the health implications.	"shale gas procedure influence health"
	Supporting arguments	To consider arguments of somebody on favour (altough the participant's position was already against)	Description of the drilling procedure. Opinions from different people. Video not hiding aspects of the problem.	"shale gas procedure"
2	Safety and security	To know about the most important thing (if it can be dangerous)	More solid information, not only showing one particular situation and perspective.	"shale gas drilling" "shale gas drilling alternatives"
	Future scenarios	To compare with other alternatives to evaluate if it is possible avoid shale gas drilling.	Benefits and disadvantages of gas extraction. How shale gas becomes available.	"natural gas" "disadvantages natural gas"
	Diverse opinions	To watch more information together.	Interest in the most important information; avoid "side notes". Statistical data. Previous experiences. Opinions from researchers or people from Universities (they are less "economically involved".	"develop natural gas" "production natural gas" "reproduction natural gas" "natural gas processing"
3	Affectation of species (flora and fauna)	It is important because humans also depend on them.	To listen to an expert such as a biologist or geologist (somebody with knowledge on Earth Sciences).	"effects of shale drilling on animals"
	Affectation of human communities	To know how humans can be affected.	To know who is making money of shale gas drilling.	"fracking dumping new work"
	Health implications	To know about the potential bad things that could happen to humans in order to prevent issues. To persuade herself against shale gas drilling.	Possible outcomes. The most recent news. Alternatives to fracking Political perspective and economic issues. Who is involved on each side.	"fracking health effects"

Table 3: Participants 1, 2 and 3: overview of motivations and expectations (before watching video) and queries made after watching it.

Partic.	Selected types of information	Motivations or reasons for choosing the fragment	Expressed information needs	Queries made after watching the fragment
4	Social and cultural dimension	To consider consequences for societies	Expert explaining the different aspects of shale gas drilling, not only one group presenting their own cultural perspective. Overview of pro and con arguments.	"shale gas" "shale gas culture" "shale gas arguments"
	Outcomes	To identify potential bad results, to decide whether to be for or against this type of initiative.	Benefits and possitive outcomes. Quick overview.	(the participant did not make a new query, he went back to a resource he had downloaded previouslyre)
	Arguments against	To challenge or test the possitive idea he had formed.	Name and level of expertise of the speaker in the video. Pollution.	"helath and safety shale gas" "radiation healthy alternatives"
5	Health implications	Is the most important factor, how it affects health.	To listen to information in common and easy words. To watch complete videos, instead of short fragments. To avoid reading long texts; she prefers to watch videos to inform herself (it is faster).	"shale gas drilling health implications"
	Arguments against	To have an overview of pros and cons (she had already decided to watch the supporting arguments after this fragment).	Summary of disadvantages. Listening to a scientist.	"shale gas" "shale gas risks"
	Supporting arguments	To retrieve a summary of the advantages.	To avoid listening to people trying to sell something. To access explanations and not just nice and persuasive phrases. Why they claim this energy is greener.	"gas drilling natural resource" "gas drilling natural energy"
6	Diverse opinions	To listen to pro and con arguments together. To listen to different alternatives and not only one idea.	To listen to experts and professionals. Overview of alternative energy resources. Pros and cons of each of the alternatives.	"alternative energy source" "shale energy"
	Supporting arguments	To know why it is useful, which are the benefits.	To avoid commercial information (it is generally not relevant). To obtain more "objective" information.	"shale gas drilling arguments" "shale gas drilling"
	Outcomes	To consider possitive and negative results.	To avoid just listening to one actor (like an NGO represenative). To have access to more outcomes together, not just one accident. To know more about negative outcomes. To listen to people that it is against.	"shale energy impacts" "shale gas positive negative"

Table 4: Participants 3, 4 and 5: overview of motivations and expectations (before watching video) and queries made after watching it.