Attitudes and opinions on climate change: a segmentation of the Italian population according to ESS 2016

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1. Introduction

Since some decades ago, scientists have put discoveries on climate change to the attention of governments and the public opinion to shed light to the increasingly consequences that human activities have brought to the environment. The effects of global warming such as the increase of the pollution of the air, the rising of the sea level due to the melting of the glaciers, the more and more frequent heavy weather and the extinction or moving of species have becoming so alarming both for the consequences for the humans and for our planet that taking actions to embrace "green" attitudes and behaviours has never been as urgent as today. Together with the effect of globalization and technological improvements, information about climate change and its consequences have spread all over the world becoming an issue for governments, institutions and public opinion.

Despite the widespread scientific conclusion that global climate change is happening, mostly human-caused, and a serious risk, public understanding of these facts and support for climate change policies is more equivocal worldwide (Lee et al., 2015). In fact, the human perception and understanding is influenced by several factors: the attention the individual posits when informed, the way that is informed, the opinion of others (relatives, friends, neighbours) and more importantly, the cognitive process that the individual uses to form an opinion about it. Cognitive schemas, corresponding to the way in which individuals organise their thinking about the world (Goldberg, 2011), depend on their reference culture, the set of symbols, values and past experiences that define how information is processed.

With the aim of discovering which are the salient aspects that are considered in shaping the public opinion about climate change, I will analyse individual perceptions and attitudes toward climate change to discover which are the cognitive schemas adopted and how they are characterised. Knowing the key elements that are used by individuals to form their opinion and the aspects of climate change that are considered more important, it will be useful for a better information of science-related issues and for the design of ad-hoc and effective campaigns and public policies for the reduction of the effects of climate change.

In section 2, it will be conducted a review of the literature on previous and related studies and it will be specified in more details the research question of this paper. In section 3 there will be described the data that will be used for the analysis, the technique adopted, the analysis performed and the

interpretation of the obtained results. Finally, in section 4 the main advantages and disadvantages of the analytical approach used for the analysis with respect to the initial research object will be discussed.

2. Literature review

Previous studies on individual opinion about climate change issues focus on the identification of the factors that affect the perception and understanding of climate change and that determine the public opinion's divisions that are currently observed. The theoretical perspectives and analytical strategies implemented are several.

In McCright et al. (2015), Eurobarometer survey data are analysed to explore the relationship between political orientation and opinion about climate change in European countries to see if a strong political polarization of the public on this issue is present, as in the United States. The results showed that in Western European countries, citizens on the right are more likely than those on the left to be sceptical about the acceptance that climate change is occurring, that it represents a serious problem, and about policies to reduce its effects.

Analysing survey data on a global scale, Lee et al. (2015) found that the predictors of climate change awareness and risk perception are not universal, but vary depending on national characteristics, region of the world explored and reference culture. For example, in the USA the most important predictors of climate change awareness are civic engagement, communication access and education, while in China are education, geographic location (urban/rural) and household income.

Another study analysed the effects of science literacy and numeracy among U.S. adults on perceived climate change risks and, differently from other authors, found that "what guides individual risk perception is not the truth of those beliefs but rather their congruence with individuals' cultural commitments" (Kahan et al., 2012).

Framed in a constructivist view of human perceptions and actions, other studies such as Lorenzoni and Pidgeon (2006) and Weber (2010) showed that changes in individual opinion and risk perception about climate change depend on personal experience, knowledge, a balance of benefits and costs and the trust in other social actors.

Given the importance and necessity to deepen the study of the aspects that are considered in shaping individual opinions, the following analysis will focus on exploring which are the cognitive schemas underlying the different opinions observed on climate change. In particular, the research will be conducted with the aim of segmenting the Italian population on the basis of the cognitive schemas used to develop their attitudes and perceptions for what concerns climate change.

3. Methodology

At this first stage of the research project, secondary analysis is performed both to test the possibility of using pre-existing data and the accuracy of their questionnaires for the purposes of this research.

The data used are the ones related to Italy, taken from the 8th Round (2016) of the European Social Survey, a standardised social survey that measures attitudes cross-nationally and longitudinally every two years of randomly selected persons over 15 years old. Data are collected via face-to-face CAPI interviews, that consist in the registration of the respondent's answers on an electronic device (smartphone, tablet, laptop) in real-time.

More specifically, the dataset extracted from the Italian ESS data is made of 1657 observations and 20 variables related to attitudes and opinions on climate change[1]. To avoid a possible sample selection bias, data are corrected with design weights, that take into account the fact that in some countries individuals have different probabilities to be included in the sample because of the sampling technique adopted.

As reported in Table 1, attitudes towards climate change are measured with different items representing several dimensions of this broad concept. Questions related to energy-saving attitudes and opinions on renewable/non-renewable energy are considered representative of the degree on which individuals take pollution, energy waste and climate change risks seriously. These two dimensions are respectively made of 3 and 7 indicators with response scales that range from 0 to 10, 1 to 6 and 1 to 5. Individual perception and opinion on climate change are detected exploring the extent to which respondents are aware of climate change, feel personal responsibility and worry about climate change and are confident in the possibility of reducing climate change at various level (personal, global, governmental action). For each of these dimensions, 3, 2 and 5 indicators are used with response scales that range from 1 to 4, 1 to 5 and 0 to 10 depending on the given question.

Observations related to missing ("no answer"), non-valid ("refusal", "don't know", "non applicable") responses or for which the questioned object is unknown (i.e. "I have not heard of this energy source before") are omitted at this stage of the analysis.

In addition, items related to the opinion towards renewable/non-renewable resource (D4-D10) and on climate change (D19) are recoded so that they all have high values corresponding to positive responses with respect to climate change and low values corresponding to negative ones.

[1] The complete list of the dataset variables, their coding and represented dimensions is reported in Table 1 of the Appendix.

Dimension	Indicators
Energy-saving attitudes	D1, D2, D3
Opinion on renewable/non-renewable energy	D4, D5, D6, D7, D8, D9, D10
Climate change awareness	D19, D21, D22
Personal responsibility towards climate change	D23, D24
Confidence in the possibility of reducing climate change	D25, D26, D27, D28, D29

Table 1. Dimensions and respective indicators of climate change from the ESS (2016).

Data are then analysed using Correlational Class Analysis (CCA), a methodological approach proposed by Boutyline (2016) and derived from Relational Class Analysis (RCA) by Goldberg (2011), that focuses on the partition of the analysed sample into classes of individuals whose cognitive structure shows similar pattern of association between measures of opinion and attitudes on relevant issues. Pearson's correlation between each response pairs is used to measure the extent to which respondents share the same cultural schema. Individuals are not grouped depending on their opinions per se, but on the patterns derived from the way they organise their thinking.

Correlational Class analysis is different from current statistical methods as it searches for similarities both among responses and groups of individuals, while cluster analysis partitions respondents exclusively according to response variables and linear regression presupposes the existence of a linear relationship between a set of predictors and an outcome independently from the characteristics of each individual. In this sense, CCA is best suited for cultural studies or on public opinion, since it allows to discover shared understandings from the study of the relationship between individual responses to variables on the analysed topic.

3.1 Analysis and interpretation of results

After having prepared and cleaned the selected data as described above, Correlational Class Analysis is performed using the 'corclass' R package that creates the network adjacency matrix with the absolute row correlations. To reduce noise and increase stability, the algorithm sets to 0 the correlations that are statistically not significant (in this case, values below 0.05). The aggregate network is then partitioned into modules using the leading eigenvector method from the 'igraph' R library. The CCA results consist in two modules of 837 and 820 observations respectively. Each class is presented as an undirected graph in which nodes correspond to the measured indicators and edges to the statistically significant correlations coefficients (significance values below 0.05 are not plotted) between each pair of nodes. The thickness of the edge's lines depends on the intensity of the correlation coefficient. The graphical representation of the indicator's correlations within each class is provided as well with colours ranging from red to dark grey depending on the sign and absolute value of the correlations.

The first class network presented in Figure 1 does not provide any straight-visible pattern. Details on the relations between the measured indicators are more visible in the related correlogram. Many responses present correlation coefficient values that are close to zero, meaning that they do not represent relevant topics to respondents in the formation of attitudes and opinions on climate change. However, this class seems to identify environmentalist (or not-environmentalists) individuals, sensitive (or not) to climate change issues, that share a positive agreement towards the fact that in Italy electricity should be generated from renewable energy sources, energy consumption reduction, awareness, worry about the change climate is facing and that believe that not-renewable energy sources should not be preferred for the generation of electricity, and that climate change is having bad impacts across the world (or vice versa).

The strongest relationships are found between items according to which electricity in Italy should be generated from solar and wind energy (positive correlation), that measure how worried individuals are about climate change and have thought about it before today (positive correlation) and that measure how worried they are on climate change and think about its impact across the world (negative relationship).

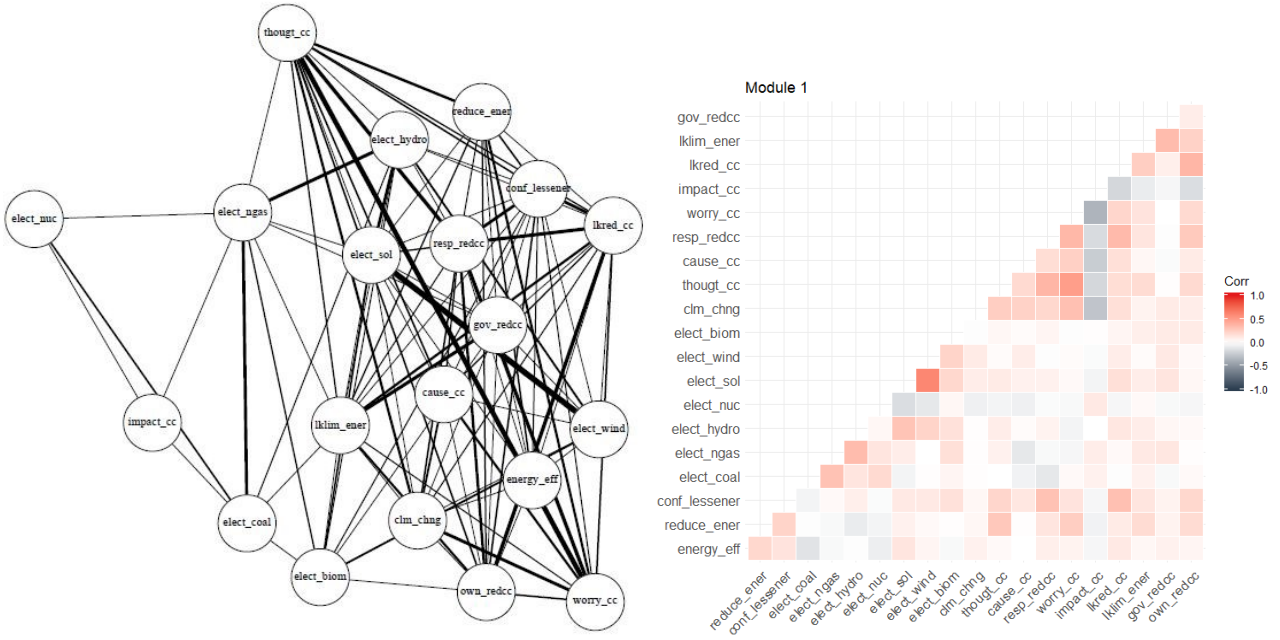

Figure 1. Network of the first class identified by CCA and corresponding correlogram.

In figure 2 it is reported the network and correlogram of the second class of individuals found with CCA. The graph seems slightly denser than the one of the first class, with more solid lines and nodes interconnections. In fact, brighter oranges and reds in the correlogram indicate more intense positive associations between variables. Individuals belonging to this class that have thought about climate

change before, that are worried, feel personal responsibility in its reduction and believe that it is mainly human caused tend less to have extreme beliefs on the bad impacts of climate change, are slightly more convinced that electricity should not be generated from coal and are more confident in the possibility of having more energy-saving attitudes and in reducing the effects of climate change by limiting the personal energy use, the one of others and by governments interventions. In this sense, this class can be described by energy-saving individuals, sensitive to climate change with a stronger trust in the possibility of reducing climate change with respect to the other class, both by limiting individual energy consumption and promoting public policies by governments to address the problem.

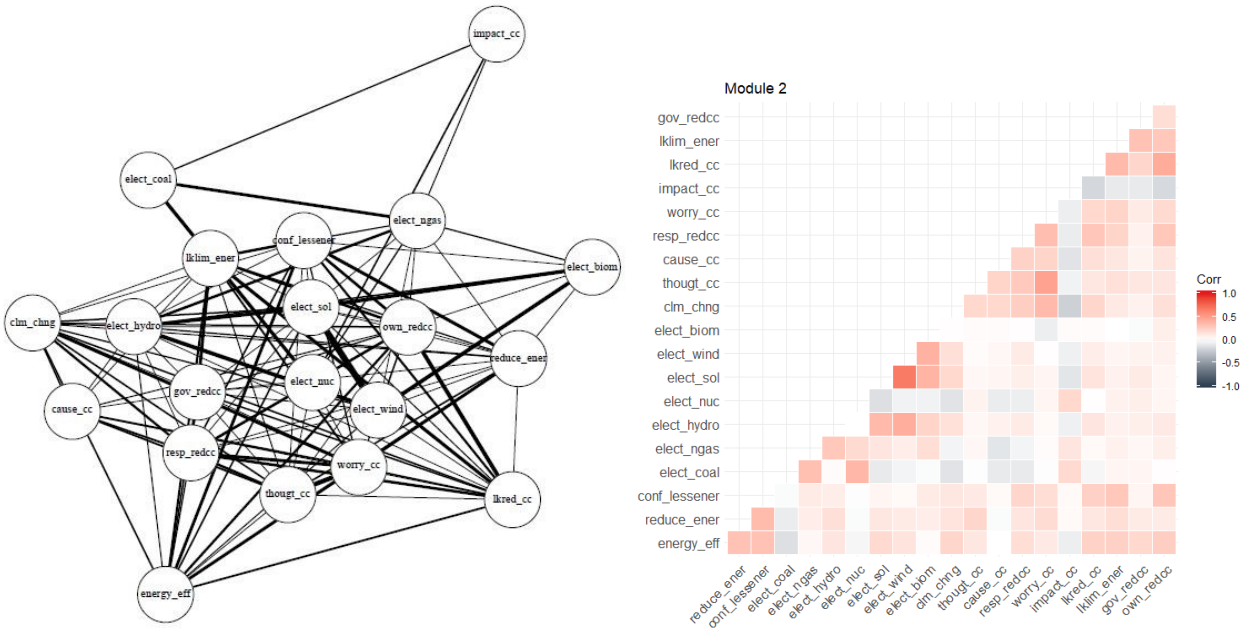

Figure 2. Network of the second class identified by CCA and corresponding correlogram.

The class partition performed by CCA has not provided the existence of particularly different cognitive schemas in Italian formation of perceptions and opinions on climate change. The differences found can be attributed to the extent to which individuals are sceptical/confident in the possibility of reducing climate change and embracing energy-saving attitudes. Thus, further analysis should be performed to assess the effectiveness of these differences found between the two classes to discover whether they are due to real dissimilarities in the orientations towards climate change or not. In addition, to further explore the characteristics of individuals belonging to the two classes, multiple regression models between a relevant climate change item (e.g. “How much though about climate change before” or “Do you think the world’s climate is changing”) and independent predictors corresponding to socio-demographic variables, such as gender, age, educational level, income, domicile information (i.e. city or country) or political orientation, could be estimated within each

class. Results of this analysis would show which predictors are consistent with the found classes and respective cognitive schemas.

4. Discussion

Correlational Class Analysis is a methodological approach that is best suited for the study of culture and cognition as it evaluates mutual relationships both at the response and individual level. With this technique it is possible to accurately segment a target population depending on its pattern of associations between different issues. As this research project aims to study data on public opinion to discover cultural schemas, it is appropriate to use Correlational Class Analysis, instead of other statistical methods such as linear regression or cluster analysis.

A possible limit of CCA technique is that it forces the sampled population to be partitioned into discrete groups, eventually leading to misleading results if the population is made of individuals each having his own mental schema or if all individuals are likely to share the same cognitive pattern. To get satisfactory results from this methodology, data should be characterised by a proper variability, so that partitions in classes will be meaningful. In addition, the indicators used to measure the concepts related to the examined social issue should be chosen properly to obtain consistent and accurate data. The limited results obtained from the CCA performed on ESS 2016 data can be due to the fact that the given questions related to attitudes and opinions on climate change are not sufficient to detect climate change opinions. In order to do so, possible advancements in the analysis could be brought integrating the given general questions on climate change to more specific items, related to daily behaviours such as the usage of public transports, attitudes towards recycling and commitment in the reduction of climate change.

5. Conclusions

Previous studies on the polarization of public opinion on climate change show that the formation of individual perceptions and understanding are both due to external factors such as scientific discoveries, opinion of others and education, and internal factors such as personal experience, internalized values and cognitive mechanism. In a constructivist optic, this research project is conducted to study the attitudes and opinions of Italians on climate change based on ESS 2016 data to discover which are the cultural schemas used to elaborate information.

Correlational Class Analysis is the statistical method used to conduct the sample segmentation according to the association of responses relative to energy-saving attitudes, opinions on renewable/not-renewable energy sources, climate change awareness, responsibility towards climate change and confidence in the possibility of climate change reduction. Two classes of individuals are

found, though sharing similar cognitive schemas. Both are characterised by individuals with energy-saving attitudes, belief in the fact that climate change is happening and that it is a serious problem. Differences regards the extent to which individuals think climate change has bad impacts across the world and the degree of confidence in the possibility that reducing personal energy consumption, of many large people and that government's actions can limit climate change[2].

The methodology used is best suited for this kind of analysis as it explores cultural data and aim to find relationships between individuals and responses at the same time. However, results are insufficient for the identification of classes of individuals with distinguished cognitive schemas. This can be due to the data at disposal or the indicators used to detect opinion on climate change. Further investigations should be made cross-sectionally, comparing different countries, and with integrated data from other aspects related to climate change to assess the persistence of the cognitive schemas found in this analysis. Indeed, the networks found represent initial empirical evidences that will be examined in depth in the course of this research project.

6. Bibliography

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[2] As CCA detects patterns of responses exploring pair-wise correlations, the found cognitive schema can either represent people in favour of climate change and sharing the opinions described above or vice versa, individuals that do not think climate change has bad impacts and that are confident in the fact that electricity should be generated from not-renewable sources.

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7. Appendix

Variable	Item	Coding	Dimension
How likely to buy most energy efficient home appliance	D1	0 (not at all likely) to 10 (extremely likely)	**Energy-saving attitudes**
How often do things to reduce energy use	D2	1 (never) to 6 (always)	
How confident you could use less energy than now	D3	0 (not at all confident) to 10 (completely confident)	
How much electricity in Italy should be generated from coal	D4	1 (none at all) to 5 (a very large amount)	**Opinions on renewable/non renewable energy sources**
How much electricity in Italy should be generated from natural gas	D5	1 (none at all) to 5 (a very large amount)	
How much electricity in Italy should be generated from hydroelectric power	D6	1 (none at all) to 5 (a very large amount)	
How much electricity in Italy should be generated from nuclear power	D7	1 (none at all) to 5 (a very large amount)	
How much electricity in Italy should be generated from solar power	D8	1 (none at all) to 5 (a very large amount)	
How much electricity in Italy should be generated from wind power	D9	1 (none at all) to 5 (a very large amount)	
How much electricity in Italy should be generated from biomass energy	D10	1 (none at all) to 5 (a very large amount)	
Do you think world's climate is changing	D19	1 (definitely not changing) to 4 (definitely changing)	**Climate change awareness**
How much thought about climate change before today	D21	1 (not at all) to 5 (a great deal)	
Climate change caused by natural processes, human activity, or both	D22	1 (entirely by natural processes) to 5 (entirely by human activity)	
To what extent feel personal responsibility to reduce climate change	D23	0 (not at all) to 10 (a great deal)	**Responsibility towards climate change**
How worried about climate change	D24	1 (not at all worried) to 5 (extremely worried)	
Climate change good or bad impact across world	D25	0 (extremely bad) to 10 (extremely good)	**Confidence in the possibility of reducing climate change**
Imagine large numbers of people limit energy use, how likely reduce climate change	D26	0 (not at all likely) to 10 (extremely likely)	
How likely, large numbers of people limit energy use	D27	0 (not at all likely) to 10 (extremely likely)	
How likely, governments enough countries take action to reduce climate change	D28	0 (not at all likely) to 10 (extremely likely)	
How likely, limiting own energy use reduce climate change	D29	0 (not at all likely) to 10 (extremely likely)	

Table 1. Description of the variables selected from the ESS (2016), their coding and dimensions.