

Mapping vaccine hesitancy in Italy.

A Correlational Class Analysis of shared understandings of vaccine uptake.

Extended abstract

Introduction

Vaccine prophylaxis is one of the major public health success of the 20th century. Although vaccinations can count on strong public support (Gellin et al., 2000), it is not a process without challenges. Several high income countries, where vaccines proved to be a fundamental public tool (Andre et. al, 2008 in Yaqub et al., 2014), are facing an expansion of a polarised partisan debate, and a significant presence of groups of individuals unwilling to vaccinate. Italy is a country that more than others is experiencing such difficulties. In 2017, 4991 cases of measles have been recorded¹, while the country reports the second highest level of vaccine-related skepticism, between Russia, first, and Azerbaijan, third (Larson, 2016:297).

In the theoretical framework of hyper-specialised risk societies (Beck, 1992; Giddens, 1999), this paper provides a two-step empirical analysis of the determinants of ‘vaccine hesitancy’, the delay or refusal of vaccine prophylaxis.

Existing empirical research mainly focuses on central tendencies of single belief-related items to estimate individual’s vaccination likelihood. However, contributions from cognitive neurosciences and cognitive sociology suggest that groups of individuals are characterised not only by same preferences, but implicit interpretative and epistemic frameworks of the same social object (DiMaggio, 1997).

Using data from an original survey on a representative sample of the Italian population, this research employs Correlational Class Analysis (CCA) to empirically exploit this notion, and cluster individuals according to their shared understanding of the vaccination issue. Each cluster is subsequently independently analysed to assess the role of individual’s characteristics, beliefs and attitudes in shaping vaccination decisions, revealing differences that might have offset each-other in the aggregate.

Preliminary results and additional analysis on a similar dataset suggest the existence of three clusters based on a different juxtaposition of risk perception and confidence in vaccine prophylaxis, whereas socio-demographic characteristics present a limited explanatory power.

This study offers a novel perspective in the way systems of health-related beliefs can be analysed, and moves one step further in underlining and disentangling the complexity of this phenomenon in contemporary society.

Theoretical framework

Vaccine hesitancy can be seen as a phenomena nested into a broader contemporary sociological debate on risk and science perception. Beck (1992) describes modernity as a “risk society”, a period where rapid technological

¹ Morbillo e Rosolia news Gennaio 2018, Istituto superiore della Sanità, Roma. www.epicentro.iss.it/problemi/morbillo/bollettino.asp

development has been accompanied by the blooming of related anxieties. Technological development reduced the perception of dangers as inevitable, and encouraged individuals to minimise risks in order to make their future secure (Giddens, 1999). Perceived hazards belong more and more to the category of “manufactured uncertainties” (Beck, 1992; Beck et al, 1994), direct but unintended consequences of scientific progress. Additionally, due to the hyper-specialisation of modern societies, individuals are less able to independently evaluate risks, forced to trust individuals and systems that they do not fully understand (Giddens, 1999). In a very specialised environment, where individuals have to delegate the knowledge on many fields, fear of unintended consequences may result in a lack of trust not only in a product, but also in the technology, science and institutions that stand behind it. This is particularly true concerning health, which has become a ‘super value’ (Price et al., 2016). Vaccinations have clearly not escaped this process (Peretti-Watel, et al., 2015).

Inside this framework, several theories have been developed to frame individual vaccine uptake and more generally health - protective behaviors. Classic theories such as the “Health Belief Model and Sick Role Behavior” by Becker (1974) and “Protection Motivation Theory” by Rogers (1975) have been able to identify the main drivers of an health-protective behaviour or intention. These constructs, variably disentangled, proved to be consistent predictors of vaccine uptake in empirical literature. The success of these model, nonetheless, seems also to stand at the bottom of a certain stagnation in the way vaccine hesitancy has been addressed.

The main limit of these models is to consider individuals as generally rational actors, maximising expected utility. Consolidated research suggests on the contrary that individuals can act only with limited rationality (Simon, 1955) and that people “rely on a limited number of heuristic principles which reduce the complex task of assessing probabilities [...]. These heuristics are quite useful, but sometimes they lead to severe and systematic errors” (Tversky & Kahneman, 1974:1124). Additionally, classic theories fail in taking into account that Individuals are embedded in complex relational networks, at the intersection of several social standpoints and in a social and cultural environment.

The key to this intricate problem might come from recent development in cognitive sciences, and from a large body of work as a coordinated study of culture and cognition (Deanna, 2014).

Contributions from the cognitive sociology suggest that groups of individuals may be characterised not only by same preferences, but also by implicit interpretative and epistemic frameworks of the same social object. “Not all people organise their thinking about the world in similar ways” (Goldberg, 2011:1398), but specific sub-groups of people might actually do it. Developing a theory-driven, reasoned comprehension of vaccine hesitancy can therefore be translated in understanding how mechanisms of cognition are used to interpret culturally specific dynamics.

Cognitive neurosciences first showed the existence of a representational and processing mechanism, generated by “*patterns of activation* across configuration of neurones that fire together in a vast network of potential combinations” (Conrey and Smith 2007 in Strandell, 2017:4)”. The tendency towards the activation of similar neural patterns, on the same social object, results in the reification of easily accessible “cognitive schemas”. Cognitive schemas can be seen as “a set of associated features representing a recurring pattern in the environment” (Strandell, 2017:3)”. Cognitive schemas are knowledge structures that “represent objects, or events and provide default assumptions about their characteristics [and] relationships [...] under conditions of incomplete informations” (DiMaggio, 1997:269).

Cognitive schemas are strongly context dependent, being individuals inserted in different social and cultural context, but also at the intersection of different situated contexts. This suggests that there might exist groups of individuals that, due to their specific social standpoint, share a similar cognitive schema on vaccine uptake, belonging to what Fleck (1936) first referenced as ‘thought communities’, groups of individuals sharing the same worldview on a specific social object or action.

Applying these concepts to vaccine hesitancy suggests that this phenomena should be investigated by looking at building blocks of cognitive activity, - cognitive schemas - and at groups that share a common understanding of the issue - thought communities. The goal of this paper is therefore to locate cognitive variation and exploit it, making cross-context comparisons and generating analytic insights.

Research questions and contribution

The research questions and hypothesis that drive this paper are:

Q1: *Do different groups of individuals share similar mental schemas on the issue of vaccine uptake?*

H1: Individuals present similar mental schemas on the issue of vaccine hesitancy and can be clustered together accordingly. Cognitive schemas can be revealed by analysing systems of beliefs.

Q2: *Do individuals in a similar cognitive-schema cluster share similar socio-demographic characteristics?*

H1: Cognitive schemas are dependent only on individual's system of beliefs on the issue, whereas socio-demographic characteristics present a limited explanatory power.

Existing empirical research mainly focused on explaining vaccine uptake through second-order values, such as vaccine safety concerns, by pointing to more fundamental first-order values, such as different risk perceptions (Jost et al., 2008). This clearly provokes the question "Where, then, do those values come from?". (Levi-Martin et al., 2010:4). This paper offers a novel point of view on the theme, investigating underlying cognitive structures and styles, standing behind individuals preferences and beliefs on the topic.

In the first part of the paper, this gap is addressed both from a theoretical and empirical point of view. Theoretically, by sustaining, through recent development of cognitive science and sociology, that it is relevant to enlighten beliefs and intentions by conceptualising them as a relational network. This will require to look at shared mental schemas, "configuration of ideas and attitudes in which the elements are bound together by some form of constraint or functional interdependence" (Converse, 1964:207 in Baldassarri et al, 2014:54). Empirically, this paper aims at testing the feasibility of exploiting survey data to infer interpretable structure of meaning that, on turn, result in the creation of cluster of individuals that share a similar view on vaccine uptake and a similar tendency on vaccine uptake.

In the second part of the paper, cluster of individuals are separately analyzed, focusing on socio-demographic characteristics of individuals. This will reveal if cognitive segmentation also functions as a way of social distinction or, on the contrary, if individuals do not cluster also according to their socio-demographic characteristics. This second result would be in line with "reflexive modernization theory" portrayed by Beck (1992) and Giddens (1999).

Data an Methods

Due to the specificity of the task this paper aims to accomplish, an original survey has been conducted to collect suitable data on vaccine hesitancy in Italy. Between September and October 2019 an on-line survey has been administered to a representative sample of the Italian population from 18 to 64 years old. Sample numerosity is 1008 cases. The questionnaire investigates three main domains. The first section tests cognitive abilities, general scientific knowledge and knowledge of vaccine-specific characteristics, as well as measures of propensity to be vaccinated or to vaccinate. The second part, drawing from existing literature on the theme, aims at investigating

in detail perceived risks, and confidence (Larson, 2016) individuals have in the product, providers and policy-makers. The third sections investigates generalised cognitive styles and a series of socio-demographic characteristics of individuals.

In the first part of the paper, to detect groups of individuals presenting a shared understanding of vaccine uptake, the method of analysis is Correlational Class Analysis (CCA). CCA is a graph partitioning method specifically designed to address the challenge of finding relational structures within and between observations. Each group is characterised by a distinctive pattern of relationships between opinions, “suggesting that its members organise their beliefs using the same schemas” (Baldassarri et al, 2014:58). More specifically, it will be shown that, to detect shared mental schemas on vaccine uptake, it could be advantageous to test degrees of linear dependency between two individuals’ vectors of responses (Boutyline, 2017).

This analysis will reveal that individuals cluster together following shared cognitive schemas, addressing one of the main issues previously introduced.

In the second part of the paper, determinants of vaccine hesitancy are tested for each group. The role of specific beliefs and the predictive ability of socio-demographic characteristics of individuals are assessed. It will be shown how the association between vaccine hesitancy propensity and specific items could have been offset or magnified without previously clustering individuals.

At the time being and to the best knowledge of the author, no publication targeted to address vaccine hesitancy in this fashion exists, and no research uses this method. Additionally, no contribution attempted to explain differences in vaccine uptake in terms of cognitive structures. This study offers a novel perspective in the way systems of beliefs can be analysed, and moves one step further in underlining and disentangling the complexity of vaccine hesitancy in contemporary society.

Expected results

A preliminary exploratory study on the feasibility of applying this approach to the study of vaccine hesitancy has recently been completed on a subset of the 2009 Eurobarometer 287 on H1N1 influenza outbreak. Although the data presented some limitations, this dataset contained specific items investigating major determinants of vaccine hesitancy that are present in the data used for the final analysis. The preliminary analysis resulted in a partition of respondents into three groups with similar cognitive structures based on respondent’s perceptions or risk and confidence in a coping response.

This preliminary study suggested three main results to focus on.

First, that it is indeed possible to cluster individuals according to their shared mental schemas on the topic of vaccine hesitancy, empirically extracting cognitive schemas from survey data. Secondly, that groups of individuals are defined by different cognitive styles based on risk and confidence perception. Third, that a lack of significant associations between vaccine uptake and sociodemographic variables could suggest that, contrary to most of the existing literature, vaccine hesitancy is an issue that cuts across socio-demographic characteristics.

Despite limitations, the preliminary analysis anticipated several results that can be expected in this paper. These are novel contributions in the study of vaccine hesitancy and in the way the study of beliefs can be empirically approached.

References

- Andre, F., Booy, R., Bock, H.L., Clemens, J., Datta, S.K., John, T.J., Lee, B.W., Lolekha, S., Peltola, H., Ruff TA, Santosham, M., Schmitt, H.J., (2008). Vaccination greatly reduces disease, disability, death and inequity worldwide. *Bulletin of the World Health Organization* 86, 140-146.
- Baldassarri, D., Goldberg, A., (2014). Neither ideologues nor agnostics: alternative voters' belief system in an age of partisan politics. *American Journal of Sociology*, 120, 1, 45-95.
- Beck, U., (1992). *Risk Society*. Sage Publications, London.
- Beck U., Giddens, A., Lash, S., (1994). *Reflexive Modernization: Politics, Traditions, and Aesthetics in the Modern Social Order*. Stanford University Press, Stanford, CA.
- Becker, M. H., (1974). The Health Belief Model and Sick Role Behavior. *Health education and behavior*, 2, 4, 409-419.
- Boutyline, A., (2017), "Improving the Measurement of Shared Cultural Schemas with Correlational Class Analysis: Theory and Method", *Sociological Science*, 4, 353-393.
doi: 10.15195/v4.a15
- Conrey, F. R., Smith, E. R., (2007). Attitude Representation: Attitudes as Patterns in a Distributed, Connectionist Representational System. *Social Cognition*, 25(5), 718–35.
- Converse, P. E., (1964), "The Nature of Belief Systems in Mass Publics", pp. 206–261 in *Ideology and Discontent*, edited by D. E. Apter. New York, Free Press.
- DiMaggio, P., (1997), "Culture and Cognition", *Annual Review of Sociology*, , 23, 263-287.
doi: <https://doi.org/10.1146/annurev.soc.23.1.263>
- Gellin, B. G., Maibach, E. W., Marcuse, E. K., (2000). Do parents understand immunizations? A national telephone survey. *Pediatrics*, 106, 1097–1102.
doi: 10.1542/peds.106.5.1097
- Goldberg, A., (2011). Mapping Shared Understandings Using Relational Class Analysis: The Case of the Cultural Omnivore Reexamined. *American Journal of Sociology*, 115, 5, 1397-1436.
- Larson, J. H., De Figueiredo, A., Xiaohong, Z., Schulz, W. S., Verger, P., Johnston, I.G., Cook, A. R., Jones, N., (2016a). The state of vaccine-confidence 2016: global insights through a 67- Country survey. *EBioMedicine*, 12/2016, 295-301.
doi: 10.1016/j.ebiom.2016.08.042
- Levi-Martin, J., Desmond, M., (2010), "Political Position and Social Knowledge", *Sociological Forum*, 25, 1, 1-26
doi: 10.1111/j.1573-7861.2009.01154.x
- Maddux, J. E., Rogers, R. W., (1983). Protection Motivation and Self-Efficacy: A Revised Theory of Fear Appeals and Attitude Change. *Journal of Experimental Psychology*, 19, 469-479
doi: 10.1016/0022-1031(83)90023-9
- Peretti-Watel P., Larson H.J., Ward J.K., Schulz W.S., Verger P., (2015). Vaccine Hesitancy: Clarifying a Theoretical Framework for an Ambiguous Notion. *PLOS Currents Outbreaks*, 1
doi: 10.1371/currents.outbreaks6844c80ff9f5b273f34c91f71b7fc289.
- Price, A. M., Peterson, L. P., (2016). Scientific progress, risk, and development: Explaining attitudes toward science cross-nationally. *International Sociology*, 31, 1, 57-80.
doi: 10.1177/0268580915614593
- Rogers, R., (1975). A protection motivation theory of fear appeals and attitude Change1. *Journal of Psychology*, 91, 1, , 93-114.
doi: 10.1080/00223980.1975.9915803
- Simon, H., (1955). A Behavioral Model of Rational Choice. *The Quarterly Journal of Economics*, Vol. 69, No.1. 99-118.
doi: 10.2307/1884852
- Strandell, J., (2017). *Culture-Cognition Interaction: Bridging Cognitive Science and Cultural Sociology*. Doctoral dissertation, University of Copenhagen.
- Tversky, A, Kahneman, D., (1974). Judgment under Uncertainty: Heuristics and Biases. *Science*, 185, 4157, 1124-1131.
doi: 10.1126/science.185.4157.1124
- Yaqub, O., Castle-Clarke S., Sevdalis N., Chataway, J., (2014). Attitudes to vaccination: A critical review. *Social Science & Medicine*, 112, 1-11.
doi: 10.1016/j.socscimed.2014.04.018