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Abstract

Background: Despite lacking scientific support, vaccine hesitancy is widespread. While serious vaccine damage as a scientific fact is real yet statistically highly uncommon, emerging social and technological forces have amplified perceptions of risk for "probable vaccine damage", making it a widely shared intersubjective reality.

Methods: Using the Eurobarometer 91.2 survey on a statistically representative EU27-UK sample interviewed in March 2019, we documented perceptions of vaccine risks and identified three belief configurations regarding vaccine effectiveness, safety, and usefulness, through exploratory cluster analysis.

Results: The public beliefs in significant vaccine risks are frequent. Approximatively one-tenth of the EU27-UK population consider that vaccines are not rigorously tested before authorization, one-third believe that vaccines can overload or weaken the immune system and that they can cause the disease against which they protect, and almost one-half believe that vaccines can cause serious side effects. We identified three belief configurations: hesitant, confident, and trade-off clusters. The hesitant type (approx. 11% of EU27-UK respondents) is defined by the perception that vaccines are rather ineffective, affected by risks of probable vaccine damage, not well-tested, and useless; the confident type (approx. 59%) is defined by beliefs that vaccines are effective, safe, well-tested, and useful; and the trade-off type (approx. 29%) combines beliefs that vaccines are effective, well-tested and useful, with perceptions of probable vaccine damage. The vaccine-confident and the trade-off types have similar vaccination histories, indicating the significant role of other factors besides beliefs in inducing behavior.

Conclusions: The high proportion of varying public beliefs in significant vaccine risks and the presence of a trade-off type of vaccination assessment indicate the social normality of beliefs in probable vaccine damage.

Communication campaigns should take into account the social normality of the perceived risk of "probable vaccine damage" across various social types, and patterns of concomitant trust and mistrust in vaccination.

Keywords

Vaccine hesitancy; vaccine damage; typology; Eurobarometer; belief configurations

Introduction

Vaccine hesitancy is one of the main global health threats, according to the World Health Organization. In recent years, measles epidemics threatening public health in the United States and in European countries were caused by low rates of vaccination. To date, acceptance of vaccination against COVID-19 is lower than needed immunization coverage in several European countries, particularly in Poland and France [1], needlessly prolonging the pandemic. In this paper, we document the distribution and configurations of vaccine-hesitant beliefs in the European Union (EU) and the United Kingdom (UK) and their relationship with vaccination behavior and sociodemographic categories, as expressed in the Eurobarometer 91.2 survey, and we discuss the significance of our findings concerning vaccination campaigns.

The Eurobarometer 91.2 data that we use for our analysis was conducted between 15th – 29th March 2019 in the EU Member States and the UK. Eurobarometers have been organized since 1973 to measure public opinion in EU member states, on a wide variety of topics. Data is available for secondary analysis via the GESIS – ZACAT catalogue[1]. This survey captured Europeans beliefs about vaccines, their vaccine-related knowledge, and the patterns of behavior related to vaccination[2].

Historically, immunization skepticism can be said to be older than vaccines themselves, since it originated with the practice of variolation that preceded vaccines and vaccination [2]. Resistance and opposition to

[1] GESIS – ZACAT catalogue : https://zacat.gesis.org/webview/

[2] GESIS Leibnitz Institute for the Social Sciences, "Eurobarometer 91.2 (2019): Europeans in 2019, The General Data Protection Regulation, Awareness of the Charter of Fundamental Rights of the European Union, and Europeans' attitudes towards vaccination".

vaccination are shaped, in intensity and distribution, by the social organization of a given epoch and society [3]. In the late nineteenth and early twentieth centuries, religious worldviews were strongly related to anti-vaccination and to the creation and propagation of anti-scientific discourses [4]. Other factors that were shaping early anti-vaccination movements were the risks carried by inoculation and vaccination, as well as political opposition to state intervention. The forces that shape anti-vaccination movements and discourses today are quite different, resulting from novel ideological, economic, and technological drives [4, 5].

Dramatic successes in fighting disease and decreases in vaccine-related adverse effects have not led to unanimous trust in science and biomedicine since they have been accompanied by structural changes that have kindled novel forms of resistance to vaccination. Increased demand for individual responsibility triggered by reflexive modernity and neoliberal capitalism [6, 7] have placed people in the emerging role of the "informed patient" [8, 9] expected to make autonomous judgments and to balance conflicting health-related assessments. In a context of media amplification of vaccine scares [7] and an online environment densely interlinked with accounts of vaccine damage [10, 11], the results of these judgments have often led to mistrust of medical authority and science. The current manifestations of global resistance to vaccination, which lead to low acceptance of vaccines despite their availability, have been conceptualized as *vaccine hesitancy* by the World Health Organization [12].

Present-day vaccine hesitancy has been shaped by a recent history of vaccine scares that raised the issue of trust in vaccination on the public agenda, including the UK pertussis controversy, the mercury poisoning controversy, and the alleged measles, mumps, rubella (MMR)–autism vaccination link [13, 14]. Country-specific threats to trust shape vaccine hesitancy and lead to decreasing vaccination coverage. In France, the H1N1 vaccination campaign from 2009 gave rise to controversies related to costs of the campaign and to scares regarding vaccine safety. The H1N1 vaccination controversy eroded French trust in vaccines, which is currently at one of the lowest levels in Europe [11]. In the case of Italy, the Court of Justice of Rimini decided to offer compensation for vaccine injury in 2012. Following this decision, MMR vaccination coverage started to decrease and a persistent lack of trust in vaccines has taken over public opinion [15].

Interestingly, vaccine hesitancy is widely fueled in media through scientifically disconfirmed assertions, such as the vaccine-autism link, continued fears of mercury contamination despite its precautionary removal [16], or the imagined overwhelming of the immune system, rather than documented cases of recent vaccine harm – such as the risks of intussusception associated with the early version of the rotavirus vaccine [13], or the risk of narcolepsy associated with the European AS03-adjuvanted A(H1N1) pandemic vaccine [14].

At the same time, the internet and, particularly, Web 2.0 with its wealth of user-generated content, social networks, and digital communities [17] have boosted the visibility and diversity of vaccine- hesitant messages [14, 19]. A complex information landscape emerged that patients and practitioners alike now have to navigate [17], from individual and organized testimonies of vaccine damage [18, 19] to pseudo-scientific theories, and from alternative views of health and well-being derived from complementary and alternative medicine [20, 18] to distorted representations of scientific research and even the propagation of fraudulent studies. People from all walks of life and all levels of expertise have learned to make their way in this new informational landscape, participating agentively and creatively in novel forms of "urban myths" [21], making vaccination decisions based on many factors. In this sensemaking effort, they are displaying variable cognitive styles [22] and divergent popular epistemologies [23], and they are developing reflexive lay methods of searching for, curating, and interpreting information [9]. The popularity of vaccine-hesitant beliefs and opinions and their diversity has gradually increased in this emerging social configuration, in which scientists and medical practitioners are only a few of the voices to be heard and trusted.

Vaccine hesitancy can be conceptualized and measured on a continuum, from low to high [24]. At the same time, it is a multidimensional phenomenon [25], which depends on perceptions of vaccine risks, benefits, effectiveness, or usefulness at the social level, as well as on the dimensions that capture people's overall assessments of risk and benefits, thus generating attitudes towards vaccination, in general, and specific vaccines, in particular [26]. A closer look at vaccine hesitancy in a population will identify diverse configurations, types of beliefs, and attitudes, which better describe people's position in regard to vaccination than unidimensional estimates. Vaccination perception can be understood through Doty's

metaphor of a “buffet of beliefs” [27], in which people combine what makes sense to them in multifarious configurations.

One interesting and worrying development consists of the emergence of widespread perceptions of probable vaccine-related harms. The scientific consensus is that serious vaccine adverse effects are real but statistically uncommon, occurring with probabilities that are degrees of magnitude lower than the harms that would be incurred through vaccine preventable diseases. Still, the public perception of vaccine-related adverse effects does not reflect this consensus [28]. In recent years, risks have become pervasive [29] and this perception of “probable vaccine damage” has been amplified, easily encountered in media by those engaged in information seeking, especially from online venues [24, 30]. Research has systematically documented large proportions of populations who believe that vaccines pose significant health risks. The popularity of these beliefs becomes self-reinforcing through processes of social construction of reality, as people contribute in the co-creation of shared worldviews that are amplified in social bubbles. The social amplification of vaccine-related risks is accomplished at institutional, group, and individual levels, as social actors experience risks, circulate information about them, and response mechanisms are elaborated [31].

Belief in vaccination harm can coexist in diverse configurations of vaccination hesitancy [27], as it can be accompanied by beliefs in vaccination effectiveness and usefulness, or generalized rejection of vaccination. There are stable dominant themes in people’s beliefs about the adverse effects of vaccines [32]. In a systematic review of 71 studies of beliefs about vaccines in the US, with a focus on barriers to vaccination among minority populations, the authors found that “The most frequently cited beliefs included that vaccines can cause illnesses; a child’s immune system can be overwhelmed if receiving too many vaccines at a time; vaccines contain harmful ingredients; younger children are more susceptible to vaccine adverse events; the purpose of vaccines is profit-making; and naturally developed immunity is better than that acquired from vaccines” [32, p. 6]. Vaccines as a cause of illnesses is a wide-ranging theme within the vaccine hesitant discourse. It goes beyond autism as a vaccine-induced condition and lists “dysfunction of the immune system, developmental and neurological disorders, behavioral issues, diabetes, liver problems,

cancer, and death" [32, p. 6] as side effects of vaccines. The "overwhelming" of the immune system and the toxicity of vaccine ingredients and mercury, in particular, are also recurrent themes within the hesitant discourses on vaccines [34]. Discursive repertoires aim to delegitimize medical research on vaccination, the health care system, and government authorities [35].

Multiple studies in diverse societies have indicated that beliefs in vaccine adverse effects and concerns about vaccine safety are widespread, both for people who vaccinate and those who reject vaccines, throughout the globe [36]. A 2010 survey of US parents of children six years of age or younger found that significant proportions of parents expressed safety concerns such as: "Vaccines may cause learning disabilities, such as autism" (30%), "The ingredients in vaccines are unsafe" (26%), "Vaccines are not tested enough for safety" (17%), and "Vaccines may cause chronic disease" (16%) [33]. These concerns were also frequently found among parents who had fully vaccinated their children or intended to do so, even if less frequently than among vaccine hesitant parents [37]. In 2010, a study of European parents found that a significant minority "have ever worried about the safety of a vaccination," ranging from 4% in Norway to 21% in Spain [38, p. 5735]. A 2012 survey of vaccine knowledge in Switzerland identified several misconceptions that were frequent among the respondents: vaccination may overload the immune system (30%), vaccinations are administered too early and prevent the development of the immune system (40%), vaccines include chemical ingredients in doses dangerous for humans (37%), vaccines lead to increased occurrence of allergies (35%), and vaccines may trigger autism, multiple sclerosis, and diabetes (16%) [39]. In a 2016 survey in Australia, the authors found overlapping trust and mistrust in vaccination [40]. In 2017, approximately 63% of Italian parents reported some worries with regard to vaccines' side effects, while another 28% were very worried about vaccine safety [41]. In a 2018 survey of parents of young children in 18 European countries, 77% of respondents agreed with the statement, "Overall, I think vaccines are safe," while 16% were not sure, and 7% disagreed [42].

Differences in sociodemographic characteristics between people who tend towards trust and people who tend towards mistrust in vaccination are not very pronounced [43], as hesitancy to vaccination permeates all

social strata and categories. Regarding beliefs on vaccine safety, a global survey across 67 countries found that perceptions of vaccine risks do not correlate with gender or education, while being stronger for younger people, the unemployed, and those in the lowest income quartile [36].

Typological studies assessing the diversity in patterns of vaccine hesitancy are relatively rare compared with linear estimates of intensity and factors, but they systematically indicate the presence of intermediate, combined configurations in which forms of trust and mistrust of vaccination coexist. An example of this is the following classification of US parents: “vaccine believer” (high level of confidence in vaccine safety), “cautious parents” (feel distress when their children are vaccinated because of emotional investment), “relaxed parents” (hold slightly negative views on vaccines), and “unconvinced parents” (hold the most negative views on vaccines) [44]. A cluster analysis of US parents who rejected HPV vaccination resulted in five groups of reasons for vaccine rejection: “pragmatic concerns about effects on sexual behavior, specific HPV vaccine concerns, moral concerns about sexual behavior, general vaccine concerns, and denial of need” [45, p. 108]. Three clusters of US people rejecting vaccination against A/H1N1 were identified while examining their potential for attitude change: “open to persuasion,” “informed unconvinced,” and “disengaged skeptics” [25]. Using latent profile analysis, three types for Australian parents active on social media were found: “accepters” (vaccine confident, intend to vaccinate), “fence sitters” (believe in benefits of vaccines, reject mandatory vaccination), and “rejecters” (reject all vaccines) [46].

Based on our proposed empirical typology of respondents in the EU and the UK, we will document how perceptions of vaccination harm are not specific to a distinctive vaccine- hesitant worldview. On the contrary, beliefs that vaccination is risky have become widespread and mainstream, making vaccine damage and vaccination risks into plausible, probable, and feared events for large segments of the population.

Methods

We devised an exploratory classification of people’s beliefs about vaccine effectiveness, risks, and usefulness among the European population. The data set was sourced from *Eurobarometer 91.2*. The weighted sample

was representative for the EU27-UK. The Eurobarometer sample was a multistage, random probability sample consisting of 27,524 respondents 15 years of age and older.

We conducted a K-means cluster analysis, classifying all respondents in the Eurobarometer sample, using IBM SPSS Statistics version 23 (IBM, Armonk, NY, USA). The K-means cluster analysis groups together similar cases within a data set, taking into account the set of criteria and the number of clusters specified by the researcher. Thus, individuals in the sample are grouped such as to minimize intra-group differences and to maximize inter-group differences concerning the mean values of the indicated classification criteria. We conducted 3-, 4- and 5- cluster classifications and we finally selected the 3-cluster classification, which we considered best in capturing the distinctive and interpretable configurations of belief at the level of the EU27-UK sample. Given the low percentage of missing observations (from 2.4% to 4.5% for cluster indicator variables), pairwise deletion was used as a method to handle missing data, thus preserving more cases in analysis in comparison to listwise deletion, while avoiding the added uncertainty of data imputation.

The variables included in our cluster analysis measured perceived effectiveness of vaccines, beliefs about vaccination risks, and beliefs about usefulness of vaccination. Indicators for each variable were recoded into dichotomous indicators to facilitate comparability and cluster interpretability.

The perceived effectiveness of vaccines was measured by the following indicator: “All the diseases mentioned earlier are infectious diseases and can be prevented. Do you think that vaccines can be effective in preventing them?” Response options included: “Yes, definitely,” “Yes, probably,” “No, probably not,” and “No, not at all,” and they were dichotomized into “Yes” (definitely or probably) or “No” (definitely or probably).

Beliefs about vaccination risks were elicited using the following prompt: “For each of the following statements, could you please tell me whether you think it is true or false….” Four items were presented with the dichotomous response options of “True” and “False,” for which we marked in parentheses the scientifically correct one: “Vaccines overload and weaken the immune system” (False), “Vaccines can cause the disease against which they protect” (False), “Vaccines can often produce serious side-effects” (False),

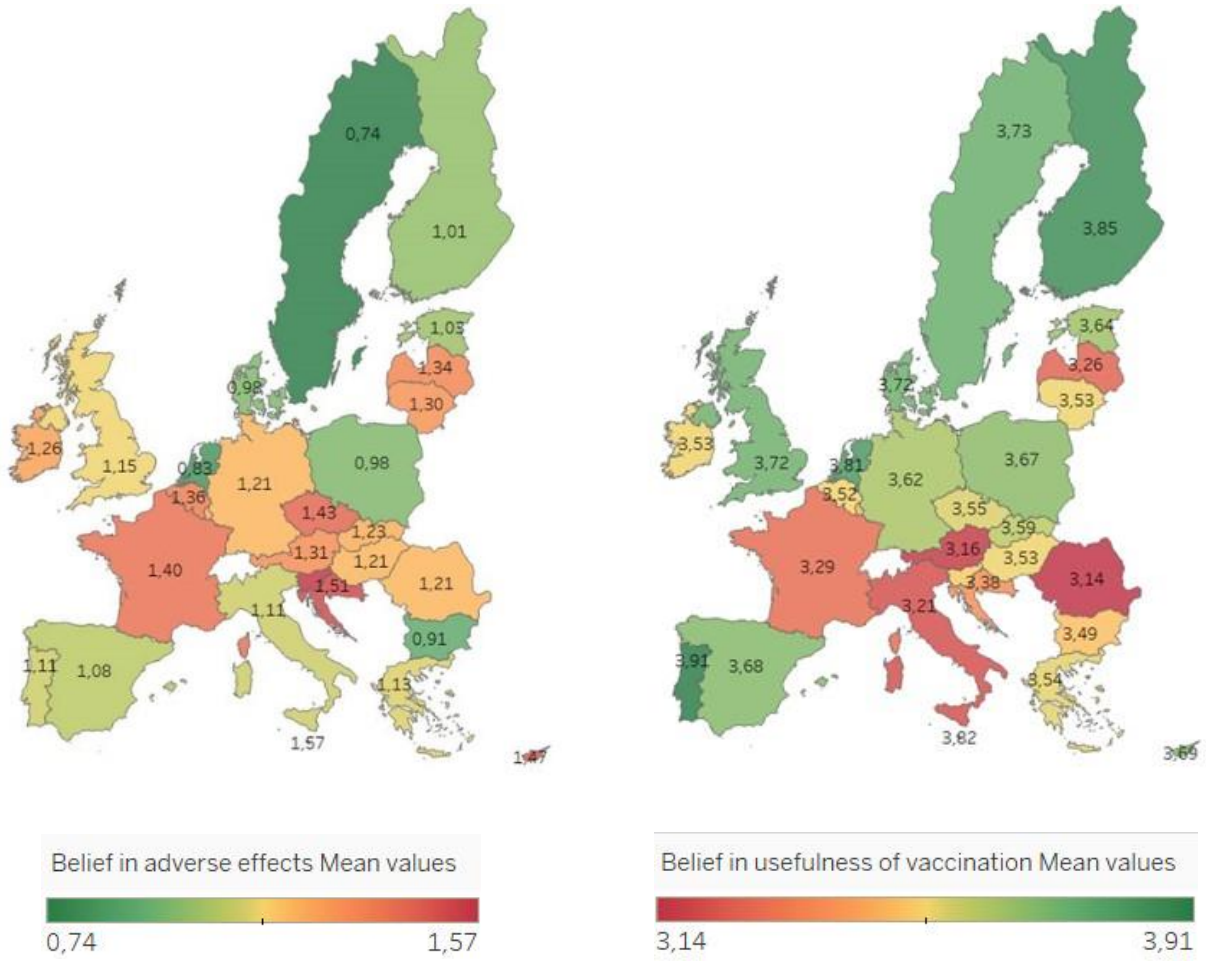
and “Vaccines are rigorously tested before being authorized for use” (True). We dichotomized variables by singling out responses that diverged from the scientific consensus and grouping uncertainty (Don’t know) with the scientifically correct responses.

Beliefs about usefulness of vaccination was measured by asking: “To what extent do you agree or disagree with the following statements?” and listing the following indicators: “It is important for everybody to have routine vaccinations,” “Vaccines are only important for children,” “Not getting vaccinated can lead to serious health issues,” “Vaccines are important to protect not only yourself but also others,” and “Vaccination of other people is important to protect those that cannot be vaccinated (e.g., newborn children, immunodepressed or very sick people).” Response options included: “Totally agree,” “Tend to agree,” “Tend to disagree,” and “Totally disagree,” which we dichotomized into “agree” or “disagree” answers.

Results

A descriptive analysis of popular beliefs in vaccine safety indicates that large segments of the population in each country consider that vaccine damage is a salient risk (see Figure 1). At the general level of the EU27-UK, approximatively one-tenth of the population consider that vaccines are not rigorously tested before authorization, one-third believe that vaccines can overload or weaken the immune system and that they can cause the disease against which they protect, and almost half of respondents believe that vaccines can cause serious side effects.

Figure 1. Country distribution of beliefs in vaccine effectiveness, risks and usefulness. Data source: Eurobarometer 91.2



The perception that vaccines are risky is not just the property of people who mistrust vaccination or science. At these levels of frequency, it has become a socially amplified risk [31], available for perception especially by exploring online information for people of all cognitive and ideological styles. In order to document how this perceived risk is distributed in patterns of beliefs regarding vaccination, we classified respondents through K-means cluster typing of their perceptions of vaccine effectiveness, safety, and usefulness. The exploratory classification yielded three distinctive patterns of belief (see Table 1). Hesitant respondents are consistently mistrustful of vaccination, rejecting its benefits and usefulness, and having a high probability of believing in vaccine adverse effects. The confident respondents display the reciprocal pattern of consistent trust in the effectiveness, safety, and usefulness of vaccines. The trade-off type combines high perceptions of vaccination risks with high assessments of vaccination effectiveness and usefulness.

Interestingly, the trade-off cluster had the highest score on all indicators of belief in vaccination harms (for example 91% of the trade-off cluster agreed that "vaccines can often produce serious side-effects" in comparison to 72% of the hesitant and 22% of the confident) with the exception of assessing vaccination testing, on which the hesitant ranked highest in mistrust (41% of the hesitant disagreed that vaccines are rigorously tested before use).

It is also noteworthy that, while respondents classified as the confident type had the lowest rates of belief in vaccination risks, the incidence was not negligible. About 13% of vaccine-confident respondents answered that "vaccine can cause the disease against which they protect," and about 22% answered that "vaccines can produce serious side-effects." Still, only about 5–6% agreed to vaccines having reactions of weakening the immune system or to vaccines not being rigorously tested.

Table 1. Exploratory classification of EU27-UK respondents according to their belief patterns on vaccine effectiveness, safety and usefulness. Method: K-Means cluster. Data source: Eurobarometer 91.2

Indicators:	**Hesitant**	**Confident**	**Trade-off**
	Mean	**Mean**	**Mean**
Do you think that vaccines can be effective in preventing diseases? *(0 No; 1 Yes)*	**0.39**	0.95	**0.90**
Vaccines overload and weaken the immune system *(0 False or DK; 1 True)*	**0.59**	0.05	**0.71**
Vaccines can cause the disease against which they protect *(0 False or DK; 1 True)*	**0.53**	0.13	**0.81**
Vaccines can often produce serious side-effects *(0 False or DK; 1 True)*	**0.72**	0.22	**0.91**
Vaccines are rigorously tested before being authorized for use *(0 True or DK; 1 False)*	**0.41**	0.06	0.10
It is important for everybody to have routine vaccinations	0.15	0.95	0.90

Indicators:	**Hesitant**	**Confident**	**Trade-off**
(0 Disagree; 1 Agree)			
Vaccines are only important for children *(0 Disagree; 1 Agree)*	0.46	0.24	0.34
Not getting vaccinated can lead to serious health issues *(0 Disagree; 1 Agree)*	0.17	0.93	**0.92**
Vaccines are important to protect not only yourself but also others *(0 Disagree; 1 Agree)*	0.32	0.98	**0.97**
Vaccination of other people is important to protect those that cannot be vaccinated (e.g. newborn children, immunodepressed or very sick people) *(0 Disagree; 1 Agree)*	0.36	0.97	**0.96**
Weighted number of cases	**3,093**	**16,376**	**8,055**
Percentage within EU27-UK (N=27,524)	**11%**	**59%**	**29%**

There is considerable country-level diversity in cluster distribution and in perceptions of probable vaccine damage (see Table 2).

Table 2. Country distribution of belief configurations regarding vaccine effectiveness, safety and usefulness. Data source: Eurobarometer 91.2

	Hesitant	**Confident**	**Trade-off**	**Total**
	Row %	**Row %**	**Row %**	**Row %**
France	18	49	32	100
Belgium	11	54	36	100
The Netherlands	3	77	20	100
Germany	8	58	34	100
Italy	20	55	25	100

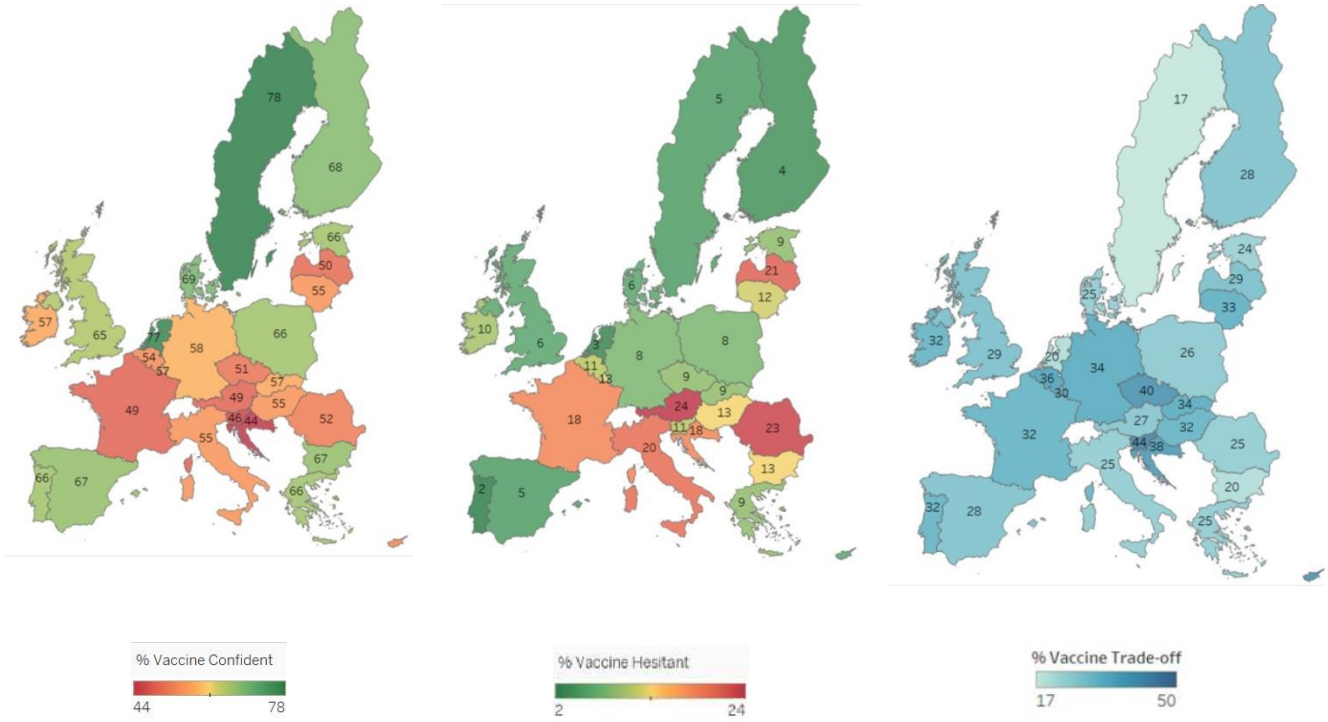
Luxembourg	13	57	30	100
Denmark	6	69	25	100
Ireland	10	57	32	100
United Kingdom	6	65	29	100
Greece	9	66	25	100
Spain	5	67	28	100
Portugal	2	66	32	100
Finland	4	68	28	100
Sweden	5	78	17	100
Austria	24	49	27	100
Cyprus (Republic)	6	53	40	100
Czech Republic	9	51	40	100
Estonia	9	66	24	100
Hungary	13	55	32	100
Latvia	21	50	29	100
Lithuania	12	55	33	100
Malta	4	46	50	100
Poland	8	66	26	100
Slovakia	9	57	34	100
Slovenia	11	46	44	100
Bulgaria	13	67	20	100
Romania	23	52	25	100
Croatia	18	44	38	100
TOTAL EU27-UK	**11**	**59**	**29**	**100**

Chi-Square tests of association statistically significant for p=0.001

In Figure 2, the red/green color scale is used to signal countries with higher/lower risks of vaccine hesitancy, respectively, while a blue scale is used to signal the distribution of the ambivalent trade-off cluster. Some countries are consistently positioned, such as France, Italy, Austria, Latvia, Greece, and Romania, which are on the red spectrum of risk given their relatively high proportions of vaccine- hesitant people and low proportions of vaccine-confident people. At the other end of the continuum, Norway, Sweden, Estonia, Poland, and Spain are consistently in a relatively favorable position for vaccination. Other countries are heterogeneously marked due to their high proportions of the ambivalent trade-off types. The Czech Republic, for example, has a relatively low proportion of vaccine-confident people (51%) but also a low percentage of vaccine- hesitant people (9%), with a high proportion of trade-off respondents that might oscillate between lower or higher vaccine hesitancy. We found Slovakia, Germany, Slovenia, and Lithuania to be in a similar situation.

Previous studies have pointed to the association between vaccine- hesitancy attitudes and populism, both related to the lack of trust in elites and experts [47]. In Italy, a country with a high proportion of vaccine-hesitant people (see Table 2), the populist party Five Stars movement endorsed the “No-Vax” movement. In countries such as Denmark and Germany, where the percentage of vaccine- hesitant configurations is relatively low, populism is not dominant in the political arena, and the population expresses a high level of trust in medical experts [47; 48]. Future research is needed to clarify political sources of nation-level variability in vaccination rejection. Our data indicate that the vaccine- hesitant people positioned themselves more frequently on the right side of an ideological continuum and were also, on average, less satisfied with life than the vaccine-confident and the trade-off types (see Table 4 below).

Figure 2. Country Distribution of vaccine-confident, vaccine-hesitant and trade-off types. Data source: Eurobarometer 91.2



As regards professed vaccination experience, the confident cluster displayed the highest proportion of respondents who either had themselves or their children vaccinated in the last five years, closely followed by the trade-off cluster. We determined a large behavioral gap between the hesitant cluster and the other two types (see Table 3).

Table 3. Distribution of vaccination behavior across clusters. Data source: Eurobarometer 91.2 (N=27524)

	Hesitant (Cluster %)	**Confident (Cluster %)**	**Trade-off (Cluster %)**	**Total (Total %)**
Has vaccinated her/himself in the last 5 years (for all respondents, N=27524)	16.1	50.2	45.4	44.9
Has vaccinated children in the last 5 years (for respondents who have children in the household, N=7260)	52.1	75.0	67.7	70.5

Chi-Square tests of association statistically significant for p=0.001

The sociodemographic profiles of the three belief clusters were largely similar. Statistical differences, even when statistically significant (due to the large sample size) were substantively small and did not indicate distinctive social categories. As previous studies [50] have shown, there is a tendency for older generations and, as a consequence, retired people to be more confident in vaccines, a tendency which was also observed in this study. People with higher and ongoing education, as well as students and managers, fall slightly more often in the vaccine-confident category than in the others (see Table 4).

Table 4. Socio-demographic profile of EU27-UK respondents across vaccine belief patterns. Data source: Eurobarometer 91.2 (N=27524)

		Hesitant (Column %)	**Confident (Column %)**	**Trade-off (Column %)**
Cluster distribution on age categories (years)	15-24	11.2	13.2	13.3
	25-34	14.6	14.6	15.4
	35-44	18.2	15.7	16.4
	45-54	18.8	16.5	17.4
	55-64	15.8	14.4	14.8
	65–74	14.9	15.7	15.2
	75+	6.4	10.0	7.4
	Total	100	100	100
Cluster distribution on occupation categories	Self-employed	7.4	7.3	6.6
	Managers	7.8	12.1	9.6
	Other white collars	13.5	11.3	12.8
	Manual workers	27.5	19.2	24.6
	House persons	4.7	5.8	5.3
	Unemployed	7.3	5.6	6.2
	Retired	24.6	28.8	26.2

		Hesitant (Column %)	Confident (Column %)	Trade-off (Column %)
	Students	7.3	9.9	8.7
	Total	100	100	100
Cluster distribution on education categories (age when stopped full-time education)	Up to 15 years	17.5	15.6	16.0
	16–19 years	44.9	39.9	46.0
	20+ years	29.4	34.0	28.8
	Still studying	7.4	10.0	8.8
	No full-time education	0.8	0.5	0.5
	Total	100	100	100
Cluster distribution on gender categories	Men	51.0	48.4	46.8
	Women	49.0	51.6	53.2
	Total	100	100	100
Cluster distribution on left-right positioning	1 (1 - 4) Left	24.5	28.0	25.3
	2 (5 - 6) Centre	29.2	35.0	37.3
	3 (7 -10) Right	21.5	18.2	19.6
	9 DK/Refusal	24.8	18.8	17.8
	Total	100	100	100
Cluster distribution on life satisfaction categories	1 Very satisfied	18.2	28.0	25.7
	2 Fairly satisfied	54.4	57.4	57.0
	3 Not very satisfied	20.1	11.3	13.8
	4 Not at all satisfied	6.9	2.8	3.4
	5 DK	0.4	0.5	0.2

		Hesitant (Column %)	Confident (Column %)	Trade-off (Column %)
	Total	100	100	100

Chi-Square tests of association statistically significant for p=0.001

Conclusions

The 2019 Eurobarometer 91.2 survey of the EU27-UK population indicates that there are large segments of the public who believe in probable vaccine damage, either in general or specifically related to immune system disorders or causing the illness they are meant to prevent. With substantial variation at the country level, we found proportions as high as 64% in Croatia and 60% in France, or as low as 26% in Sweden, who considered that "Vaccines can often produce serious side-effects," with a EU27-UK average of almost half subscribing to this belief (48%). Therefore, we consider that "probable vaccine damage" has become a socially amplified risk, co-generated by social actors who offer and seek information from online and offline sources in a diverse social space of vaccine knowledge, experience, and trust in science and medical authority.

Beliefs in probable vaccine damage are not limited to people who mistrust vaccines. We identified three patterns of beliefs as regards vaccine effectiveness, safety, and usefulness: the hesitant, the confident, and the trade-off types. While the hesitant are relatively low on vaccine trust in all three dimensions, and the confident are relatively high, the trade-off type displays a combination of beliefs in probable vaccine damage (higher than the hesitant, on average) with trust in vaccine effectiveness, testing, and usefulness. The confident and the trade-off types have largely similar professed vaccination histories, with superior rates for the confident, while the hesitant have much lower rates of vaccination for themselves and for their children. Moreover, there are no strong sociodemographic differences among the three belief clusters, though the hesitant are more likely to position themselves on the right side of an ideological continuum and to be less satisfied with life.

The concomitance of beliefs in probable vaccine damage and effectiveness, testing, and usefulness of vaccines has implications for designing public communication campaigns. In particular, campaigns that focus on the value of vaccines in preventing disease will not address the subjective reality of vaccination damage, which is shared by large segments of the public that otherwise trust vaccination. For example, Romania is one of the countries with a high proportion of trade-off respondents. Romania has also suffered from an ongoing measles epidemic since 2016, which has infected more than 19,500 people and led to 64 deaths as reported on April 3, 2020[3]. The Romanian state has conducted a media campaign under the slogan "Vaccination saves lives" including three videos that focus on the effectiveness and usefulness of vaccination against disease, in history and today[4]. Still, in light of the present findings, it becomes clear that such a campaign, which is aimed at the hesitant (about 23% in Romania), does not address the trade-off segment of the public, comprising about 25% of Romanian respondents. In Romania's campaign and in global vaccination campaigns, new patterns of public communication about vaccination are needed to address the socially amplified risk of probable vaccine damage and to consider the trade-off patterns of concomitant trust and mistrust in assessing vaccines.

Limitations

The most important limitation of our study is the fact that, due to the available Eurobarometer data, we discuss vaccine hesitancy in general, rather than for specific vaccines such as MMR, HPV, seasonal flu, H1N1, etc., thus ignoring the specificity of vaccination concerns. Also, cluster analysis captures homogenous patterns of beliefs across the EU27-UK population, while overlooking some of the national or regional variations of the phenomenon. Last but not least, intense controversies related to the COVID-19 vaccination will likely influence the social representations of vaccination risks across the world.

[3]National Institute for Public Health in Romania, Situation of Measles in Romania. April 3, 2020 Report. Available online at https://www.cnscbt.ro/index.php/informari-saptamanale/rujeola-1/1622-situatia-rujeolei-in-romania-la-data-de-03-04-2020/file

[4]Videos are available on the YouTube channel of the Romanian Ministry of Health, under the titles: "Vaccinurile salvează vieți - Paula Rusu" (about tuberculosis), "Vaccinurile salvează vieți - Victor Rebengiuc" (about the history of vaccination and polio), and "Vaccinurile salvează vieți - Ioana Grozea" (about childhood vaccination in general). Available online at https://www.youtube.com/channel/UCAR1cIye4_xGGZoBZvvjMQQ

Author contribution

All authors made a significant contribution to the development of this manuscript and approved the final version for submission.

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Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

Table 5. Country distribution of beliefs in vaccine effectiveness, risks and usefulness. Data source: Eurobarometer 91.2

References

[1] J. V. Lazarus *et al.*, “A global survey of potential acceptance of a COVID-19 vaccine,” *Nat. Med.*, 2020.

[2] S. Riedel, “Edward Jenner and the History of Smallpox and Vaccination,” *Baylor Univ. Med. Cent. Proc.*, vol. 18, no. 1, pp. 21–25, Jan. 2005.

[3] E. Dubé, M. Vivion, and N. E. MacDonald, “Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: Influence, impact and implications,” *Expert Rev. Vaccines*, vol. 14, no. 1, pp. 99–117, 2014.

[4] P. Hobson-West, “Understanding vaccination resistance: moving beyond risk,” *Health. Risk Soc.*, vol. 5, no. 3, pp. 273–283, 2003.

[5] E. J. Sobo, A. Huhn, A. Sannwald, and L. Thurman, “Information Curation among Vaccine Cautious Parents: Web 2.0, Pinterest Thinking, and Pediatric Vaccination Choice,” *Med. Anthropol. Cross Cult. Stud. Heal. Illn.*, vol. 35, no. 6, pp. 529–546, Nov. 2016.

[6] S. Blume, “Anti-vaccination movements and their interpretations,” *Soc. Sci. Med.*, vol. 62, no. 3, pp. 628–642, 2006.

[7] E. Dubé, C. Laberge, M. Guay, P. Bramadat, R. Roy, and J. Bettinger, “Vaccine hesitancy An overview,” *Hum. Vaccin. Immunother.*, vol. 9, no. 8, pp. 1763–1773, 2013.

[8] C. Betsch, F. Renkewitz, T. Betsch, and C. Ulshöfer, “The influence of vaccine-critical websites on perceiving vaccination risks.,” *J. Health Psychol.*, vol. 15, no. 3, pp. 446–55, Apr. 2010.

[9] R. Z. Zimmerman *et al.*, “Vaccine Criticism on the World Wide Web,” *J. Med. Internet Res.*, vol. 7, no. 2, p. e17, 2005.

[10] J. P. Baker, “Mercury, Vaccines, and Autism One Controversy, Three Histories,” *Am. J. Public Health*, vol. 98, no. 2, pp. 244–253, 2008.

[11] J. K. Ward, J. Colgrove, and P. Verger, “Why France is making eight new vaccines mandatory,” *Vaccine*, vol. 36, no. 14, pp. 1801–1803, 2018.

[12] World Health Organization, “Report on the Sage Working Group on Vaccine Hesitancy,” 2014.

[13] J. Bines, “Intussusception and rotavirus vaccines,” *Vaccine*, vol. 24, no. 18, pp. 3772–3776, May 2006.

[14] S. S. Ahmed, P. H. Schur, N. E. MacDonald, and L. Steinman, “Narcolepsy, 2009 A(H1N1) pandemic influenza, and pandemic influenza vaccinations: What is known and unknown about the neurological disorder, the role for autoimmunity, and vaccine adjuvants,” *Journal of Autoimmunity*, vol. 50. Academic Press, pp. 1–11, May-2014.

[15] F. Aquino, G. Donzelli, E. De Franco, G. Privitera, and P. L. Lopalco, “The web and public confidence in MMR vaccination in Italy,” *Vaccine*, vol. 35, no. 35, pp. 4494–4498, 2017.

[16] M. Bigham and R. Copes, “Thiomersal in vaccines: Balancing the risk of adverse effects with the risk of vaccine-preventable disease,” *Drug Safety*, vol. 28, no. 2. Springer, pp. 89–101, Nov-2005.

[17] Ş. Matei, “Responsibility beyond the grave: Technological mediation of collective moral agency in online commemorative environments,” *Des. Issues*, vol. 34, no. 1, pp. 84–94, Jan. 2018.

[18] C. Toth, “The rational, loving and responsible parent. A discursive construction of the identities of the parents that decided not to vaccinate their children,” *J. Comp. Res. Anthropol. Sociol.*, vol. 10, no. 2, 2019.

[19] C. Toth, “‘To Vaccinate or not to Vaccinate my Child?’ What Is at Stake in Vaccination Repertoires?,” *Educ. J. Res. Debate*, vol. 3, no. 8, pp. 1–6, 2020.

[20] J. A. Reich, “Neoliberal Mothering and Vaccine Refusal,” *Gend. Soc.*, vol. 28, no. 5, pp. 679–704, Oct. 2014.

[21] R. Gasparini, D. Panatto, P. L. Lai, and D. Amicizia, “The ‘urban myth’ of the association between neurological disorders and vaccinations,” *Journal of Preventive Medicine and Hygiene*, vol. 56, no. 1. Pacini Editore S.p.A., pp. E1–E8, 2015.

[22] C. M. Poland and G. A. Poland, “Vaccine education spectrum disorder: the importance of incorporating psychological and cognitive models into vaccine education,” *Vaccine*, vol. 29, no. 37, pp. 6145–6148, 2011.

[23] D. Numerato, L. Vochocová, V. Štětka, and A. Macková, “The vaccination debate in the ‘post-truth’ era: social media as sites of multi-layered reflexivity,” *Sociol. Health Illn.*, vol. 41, no. S1, pp. 82–97, Oct. 2019.

[24] S. Quinn, A. Jamison, D. Musa, K. Hilyard, and V. Freimuth, “Exploring the Continuum of Vaccine Hesitancy Between African American and White Adults: Results of a Qualitative Study,” *PLOS Curr.*, vol. 8, 2016.

[25] S. Ramanadhan, E. Galarce, Z. Xuan, J. Alexander-Molloy, and K. Viswanath, “Addressing the Vaccine Hesitancy Continuum: An Audience Segmentation Analysis of American Adults Who Did Not Receive the 2009 H1N1 Vaccine,” *Vaccines*, vol. 3, pp. 556–578, 2015.

[26] N. E. MacDonald, “Vaccine hesitancy: Definition, scope and determinants,” *Vaccine*, vol. 14, no. 33, pp. 1–4, 2015.

[27] C. Doty, “Misinformation on the Internet?: A Study of Vaccine Safety Beliefs,” UCLA, 2015.

[28] C. Doty, “Social Epistemology and Cognitive Authority in Online Comments about Vaccine Safety,” in *iConference 2015 Proceedings*, 2015.

[29] E. Gardella and J. Souloumiac, “Entretien avec Robert Castel Propos recueillis par Edouard Gardella et Julien Souloumiac,” *Tracés. Rev. Sci. Hum.*, vol. 6, pp. 103–112, 2004.

[30] N. Smith and T. Graham, “Mapping the anti-vaccination movement on Facebook,” *Inf. Commun. Soc.*, vol. 22, no. 9, pp. 1310–1327, Jul. 2019.

[31] R. E. Kasperson *et al.*, “The Social Amplification of Risk A Conceptual Framework,” *Risk Anal.*, vol. 8, no. 2, pp. 177–187, 1988.

[32] M. E. Díaz Crescitelli *et al.*, “A meta-synthesis study of the key elements involved in childhood vaccine hesitancy,” *Public Health*, vol. 180, pp. 38–45, 2020.

[33] C. Gidengil, C. Chen, A. M. Parker, S. Nowak, and L. Matthews, “Beliefs around childhood vaccines in the United States: A systematic review,” *Vaccine*, vol. 37, no. 45. Elsevier Ltd, pp. 6793–6802, Oct-2019.

[34] R. Casiday, “Risk and trust in vaccine decision making,” *Durham Anthropol. J.*, vol. 13, no. 1, pp. 1–10, 2005.

[35] C. Toth, “Repertoires of Vaccine Refusal in Romania,” *Vaccines*, vol. 8, no. 757, pp. 1–16, 2020.

[36] H. J. Larson *et al.*, “The State of Vaccine Confidence 2016: Global Insights Through a 67-Country Survey,” *EBioMedicine*, vol. 12, pp. 295–301, 2016.

[37] A. Kennedy, K. LaVail, G. Nowak, M. Basket, and S. Landry, “Confidence about vaccines in the United States: Understanding parents’ perceptions,” *Health Aff.*, vol. 30, no. 6, pp. 1151–1159, Jun. 2011.

[38] P. Stefanoff *et al.*, “Tracking parental attitudes on vaccination across European countries: The Vaccine Safety, Attitudes, Training and Communication Project (VACSATC),” *Vaccine*, vol. 28, pp. 5731–5737, 2010.

[39] A. Zingg and M. Siegrist, “Measuring people’s knowledge about vaccination: Developing a one-dimensional scale,” *Vaccine*, vol. 30, no. 25, pp. 3771–3777, May 2012.

[40] M. Y. K. Chow, M. Dankin, H. W. Willaby, S. Pemberton, and J. Leask, “Parental attitudes, beliefs, behaviours and concerns towards childhood vaccinations in Australia: A national online survey,” *Aust. Fam. Physician*, vol. 46, no. 3, 2017.

[41] F. Napolitano, A. D’Alessandro, and I. F. Angelillo, “Investigating Italian parents’ vaccine hesitancy: A cross-sectional survey,” *Hum. Vaccin. Immunother.*, vol. 14, no. 7, pp. 1558–1565, Jul. 2018.

[42] A. Hadjipanayis *et al.*, “Vaccine confidence among parents: Large scale study in eighteen European countries,” *Vaccine*, vol. 38, no. 6, pp. 1505–1512, Feb. 2020.

[43] M. J. Hornsey, E. A. Harris, and K. S. Fielding, “The Psychological Roots of Anti-Vaccination Attitudes: A 24-Nation Investigation,” *Heal. Psychol.*, vol. 37, no. 4, pp. 307–315, 2018.

[44] M. T. Keane *et al.*, “Confidence in vaccination: a parent model,” *Vaccine*, vol. 23, no. 19, pp. 2486–2493, 2005.

[45] N. A. Constantine and P. Jerman, “Acceptance of Human Papillomavirus Vaccination among Californian Parents of Daughters: A Representative Statewide Analysis,” *J. Adolesc. Heal.*, vol. 40, no. 2, pp. 108–115, 2007.

[46] I. Rossen, M. J. Hurlstone, P. D. Dunlop, and C. Lawrence, “‘Accepters’, ‘fence sitters’, and ‘rejecters’,” *Soc. Sci. Med.*, vol. 224, pp. 23–27, 2019.

[47] J. Kennedy, “Populist politics and vaccine hesitancy in Western Europe: An analysis of national-level data,” *Eur. J. Public Health*, vol. 29, no. 3, pp. 512–516, 2019.

[48] E. Pavolini, E. Kuhlmann, T. I. Agartan, R. Mannion, and E. Speed, “Healthcare governance, professions and populism: is there a relationship? An explorative comparison of five European countries,” *Health Policy (New. York).*, vol. 122, no. 10, pp. 1140–1148, 2018.

[49] J. Luyten, L. Bruyneel, and A. J. van Hoek, “Assessing vaccine hesitancy in the UK population using a generalized vaccine hesitancy survey instrument,” *Vaccine*, vol. 37, pp. 2494–2501, 2019.

Appendix A. Supplementary material

Table 5. Country distribution of beliefs in vaccine effectiveness, risks and usefulness. Data source: Eurobarometer 91.2

	Are vaccines effective	Vaccines overload and weaken the immune system	Vaccines can cause the disease against which they protect	Vaccines can often produce serious side effects	Vaccines are not rigorously tested before being authorized for use	It is important for everybody to have routine vaccinations	Vaccines are only important for children	Not getting vaccinated can lead to serious health issues	Vaccines are important to protect not only yourself but also others	Vaccination of other people is important to protect those that cannot be vaccinated
	%	%	%	%	%	%	%	%	%	%
Total – EU27-UK	**87**	**31**	**38**	**48**	**11**	**85**	**29**	**85**	**91**	**91**
Austria	75	42	39	51	12	76	38	76	78	81
Belgium	81	34	48	53	9	83	33	83	94	92
Bulgaria	79	25	25	41	7	89	45	80	88	87
Croatia	81	45	43	64	18	84	45	80	84	86
Cyprus (Republic)	85	39	42	65	8	93	21	87	93	94
Czech Republic	91	46	45	53	8	93	32	79	90	91
Denmark	94	21	42	35	8	91	9	92	96	92
Estonia	88	30	32	41	8	88	26	86	93	94
Finland	97	16	44	41	11	95	14	95	98	97

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France	84	34	45	60	12	70	18	76	89	89
Germany	89	33	42	46	8	88	20	88	91	92
Greece	90	29	30	53	9	86	33	84	90	93
Hungary	82	39	38	44	16	88	48	85	88	89
Ireland	89	34	35	57	11	82	37	86	91	92
Italy	79	31	34	46	18	73	50	79	83	84
Latvia	71	39	39	55	12	76	33	71	87	88
Lithuania	84	31	44	55	8	89	38	78	91	92
Luxembourg	88	30	38	53	9	80	18	82	93	88
Malta	97	43	51	62	1	91	17	94	97	95
Poland	85	28	30	40	13	94	53	91	91	89
Portugal	93	28	34	50	4	97	21	97	99	98
Romania	76	33	36	53	20	77	52	76	79	81
Slovakia	87	37	37	49	7	90	41	88	89	91
Slovenia	85	49	47	60	7	87	34	83	91	90
Spain	95	28	37	43	9	93	16	85	96	93

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Sweden	96	15	33	26	7	88	12	91	96	97
The Netherlands	98	15	38	29	4	95	10	92	97	96
United Kingdom	92	27	33	54	7	89	22	90	96	95

Chi-Square tests of association statistically significant for p=0.001