International Journal of Applied Behavioral Economics
Volume 10 • Issue 4

How Does Communicating Herd Immunity Affect Immunization Intentions?

Evidence From a Cross-Country Online Experiment

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ABSTRACT

While previous studies have shown that communicating herd immunity can increase immunization intentions, it is unclear how the definition of the beneficiaries influences intentions. In a vignette study, using a new hypothetical influenza virus, 4,172 participants from five European countries (Bulgaria, N=873; Denmark, N=896; England, N=873; Estonia, N=916; and Italy, N=745) were randomized to one of three experimental conditions: (1) control (no mention of herd immunity), (2) society (social benefit of immunization for overall society mentioned), and (3) friends (social benefit for friends and family members mentioned). While the study did not find that communicating herd immunity influenced overall immunization intentions across the five countries, it found substantial cross-country differences in the effect of the communication. In England, friends increased intentions, while society increased intentions in Denmark but decreased it in Italy. While communicating the social benefit of immunization can influence intentions, its contrasting effects highlight the importance of empirically testing.

KEYWORDS

Behavioural Intervention, Communication, Decision Making, Framing, Herd Immunity, Immunization, Nudge, Online Experiment

INTRODUCTION

Several theoretical studies have defined the immunization decision as a trade-off between the perceived utility of immunization and non-immunization (Bauch & Earn, 2004; Bauch et al., 2010; Betsch et al., 2013; Brewer & Fazekas 2007; Galvani et al., 2007; Manfredi et al., 2009; Nguyen et al., 2011). The utilities are thereby defined as the difference between expected costs of contracting the virus and side-effects of vaccination, while the costs are either the product of the severity and the probability of infection or the product of the severity and the probability of side-effects. A rational individual would only get immunized if the perceived utility of immunization is higher than the expected utility of infection. Immunization, however, does not only yield a direct effect on reducing the risk

DOI: 10.4018/IJABE.2021100102

of infection, but it also has an indirect social effect of reducing the transmission of the virus, called herd immunity (Fine et al., 2011).

Assuming that the cost of immunization is independent of the number of individuals getting vaccinated, making this indirect effect of immunization salient could influence the perceived utility of immunization and non-immunization. There have been several studies looking at the effect of communicating the social benefit of immunization on attitudes and intentions (see Hakim et al., 2019 for a recent systematic review). Individuals whose utility does not only depend on their wellbeing but also on those of their social environment perceive the utility of immunization as higher when herd immunity is known (Shim et al., 2012; Betsch et al., 2013). Differently, communicating herd immunity can also decrease immunization intentions for self-serving individuals (Dawes, 1980). The awareness of herd immunity increases the perceived utility of non-immunization for these individuals as they believe that more people would get immunized (Hershey et al.1994; Bauch & Earn, 2004; Manfredi et al., 2009; Betsch et al., 2013). As the risk of infection reduces with the number of individuals immunized, the individual benefit of getting immunization decreases. Individuals may, therefore, decide to free-ride and profit from herd immunity, avoiding individual costs of immunization (Fine et al., 2011; Betsch et al., 2013). Empirical evidence appears consistent with these conjectures. Research using experimental surveys has shown that communicating herd immunity can increase free-riding behaviour when the message emphasized the individual benefit of others getting immunized (Betsch et al., 2013). Differently, several studies have shown that explaining the concept of herd immunity can increase the willingness to be vaccinated in western countries and when the cost of immunization is low and non-vaccinators have low responsibility (Arnesen et al., 2018; Betsch et al., 2017, Böhm et al., 2019). While these results suggest that herd immunity influences immunization intentions, it is not clear how the definition of its beneficiaries influence the reaction to the message. While experimental studies on social preferences have shown that individuals are motivated by the wellbeing of others, individual may hold social identities at various levels of abstraction, ranging from concrete groups of individuals (e.g., own friends and family) to broader categories of individuals such as citizens of their country (Andreoni et al., 2008; Charness & Gneezy, 2008). Previous studies on social preferences have shown that individuals exhibit more altruistic preferences if they know more about the potential recipients, such as their social belonging (Eckel & Grossman, 1996; Bohnet & Frey, 1999; Burnham, 2003; Charness & Gneezy, 2008). Similarly, other studies show that altruistic behaviour is negatively related to social distance; e.g. whether beneficiaries are close friends or not (Jones & Rachlin, 2006; Leider et al. 2009; Goeree et al. 2009). As such, individual intention to get immunized for the benefit of others may depend on the social distance between the decision-maker and the beneficiaries of herd immunity.

THE CURRENT RESEARCH

The purpose of the current research was to explore how the framing of herd immunity influences vaccination intentions. Specifically, we investigated whether the definition of the beneficiaries of herd immunity affects immunization intentions. In line with studies on social distance and altruism, we expected that highlighting the indirect effect of immunization for the close social environment would increase immunization intentions. In line with the theory that immunization is a strategic decision, we predict that individuals are less willing to get immunized as they believe that others would get vaccinated when they hear about the social benefit of immunization.

METHOD

Procedure

A web-based experimental survey was developed on SurveyMonkey to determine how the framing of herd immunity influences vaccination intentions in five European countries (Bulgaria, Denmark, England, Estonia and Italy). The survey was conducted in 2015 and featured representative samples of men and women aged 18–54 years who were invited by a survey vendor (Norstat) to take part in an online survey on immunization. Study participants who completed the survey received a small financial incentive from the survey vendor, which was defined by the length of the questionnaire and varied across the five countries. Study participants who were filtered out or dropped out of the survey did not receive an incentive.

At the start of the survey, study participants were asked to give explicit consent for their data to be used and published as part of this research project before they could continue in the survey. We then collected information about the participants' sociodemographic characteristics such as age, education and employment. Screening questions on age and gender were used to make the samples as nationally representative as possible. After these questions, study participants were individually randomised to one of three experimental vignettes with different information about a new hypothetical influenza virus. Each participant was told about a virus that can cause severe pain and illness for around two weeks. The information further stated that the most common symptoms of this virus are headache, muscle pain and general discomfort. While the virus is not lethal for normal healthy people, it can cause serious health problems or even death for vulnerable people such as small children, elderly and chronically sick people. The virus is highly contagious and vaccination can reduce the risk of getting and spreading the virus. The vaccination has mainly only small side-effects in the form of potential nausea and mild discomfort for some days after the vaccination. Furthermore, the description of the virus also contained information about the beneficiaries of the vaccination. For those in the *control* condition, the final paragraph stated that they should imagine having read an advertisement from their local ministry of health to get vaccinated to reduce their own risk of getting the virus. Those in the *society* condition were given the sentence: "Imagine that you read an advertisement from your local ministry of health to get vaccinated to reduce your own risk of getting the virus and protect the most vulnerable people in your country from getting the virus", while those in the *friends* condition received the sentence: "Imagine that you read an advertisement from your local ministry of health to get vaccinated to reduce your own risk of getting the virus and protect your most vulnerable friends and family members, such as your children, your parents or your grandparents from getting the virus." The allocation ratio for the three parallel conditions was 1:1:1.

The primary outcome was the intention to get vaccinated against the new influenza virus. This was measured using the question: "Would you get vaccinated against the virus?" with responses on a partially labelled eight-point scale, where 1 meant that one would definitely not get vaccinated and 8 indicated that one would definitely get vaccinated.

The secondary outcomes focused on the impact of the beneficiaries' description on the expectation of peer's behaviour and perception of the immunization programme. To explore if the communicating herd immunity had an impact on the perceived importance of the immunization programme, we included the question: "Do you believe that getting vaccinated against the virus is socially important?". Additionally, we asked study participants whether they thought that most people would get immunized with the question: "Do you think that most people will get vaccinated?" Both items featured a "Yes" and a "No" response options.

We further asked study participants to state their perceived health status and risk preference with the questions: "How would you describe your overall health?" and "Would you describe yourself as a risk-taker?". Both items featured partially labelled eight-point Likert scales. In the case of the health question, 1 meant that their health was very poor and 8 meant excellent. For the risk question, 1 meant that they would always play it safe while 8 meant they would always take the risk. Both, the self-rated

health question and the risk preference question were adapted from previous studies (Eriksson et al., 2001; Dohmen et al., 2011). Survey questions were pilot-tested with a small sample of 142 English participants and revised according to respondents' comments before fielding.

We used the health and risk questions as well as the sociodemographic variables as covariates in multivariable ordered logistic regressions to investigate the effect of the experimental conditions on immunization intentions. The sample size was calculated before data collection based on estimates obtained from the pilot study. The calculation indicated that we needed at least 250 individuals per experimental group and country to detect a difference of at least 10% in the proportion of non-intenders effect size per condition, with a power of 80% at the 5% level of significance.

We compare overall screening intentions across the three experimental condition (i.e., for all five countries), as well as intentions in each country. While we only report adjusted odds ratios (aORs) and 95% confidence intervals (95% CIs) the experimental manipulation in the text, the full models showing all the covariates are displayed in Supplementary Tables 2, 3 and 4. The statistical analysis was conducted with Stata/SE version 15.1 (StataCorp LP, College Station, TX). The research project received full ethical approval of the institute's ethics committee. While the design and analysis plan of the experiment were not preregistered, all data and materials are publicly available via the Open Science Framework and can be accessed at https://osf.io/8wukj/.

RESULTS

Participants

The experimental study used a sample of 4172 individuals from Bulgaria (N=873), Denmark (N=896), Estonia (N=916), Italy (N=745) and England (N=742). Most participants were aged between 18 and 29 (20.9%), had paid work (66.8%), did not have a university degree (65.8%), reported relatively good health (Mean 6.22 out of 8), and were relatively risk-neutral (Mean 4.35 out of 8). There were no statistically significant differences in sociodemographic characteristics, health status and risk preferences, indicating that there were no imbalances due to levels of drop-out varying among the three experimental conditions (see Supplementary Table S1 for the overall population and Tables S1a-e for the individual countries).

Effect on Immunization Intentions

The distributions of the immunization intentions are presented in Figure 1. Most study participants stated that they would definitely get vaccinated.

The results of the ordered logistic regression, reported in Table 1, showed that, compared with the *control* condition, the *society* and *friends* conditions did not increase overall immunization intentions (aOR: 1.02; 95% CI: 0.89–1.16 and aOR: 1.13; 95% CI: 0.99–1.29).

An examination of immunization intentions within the five countries in Table 1 reveals, however, that communicating the social benefit for friends and family increased immunization intentions in Denmark (aOR: 1.49; 95% CI: 1.12–1.98) and decreased it in Italy (aOR: 0.61 95% CI: 0.45–0.84). Differently, while presenting the social benefit of immunization for friends and family increased immunization intentions in England (aOR: 1.52; 95% CI: 1.10–2.10), it did not affect immunization intentions in any other countries.

Effect on the Perceived Social Importance of the Immunization Programme

In line with the high overall immunization intentions, most study participants thought that getting vaccinated is socially important (63.6% in *control*, 64.9% in *society* and 67.0% in *friends*). There was no statistically significant difference across the experimental

Figure 1. Distribution of immunization intentions across the three experimental conditions

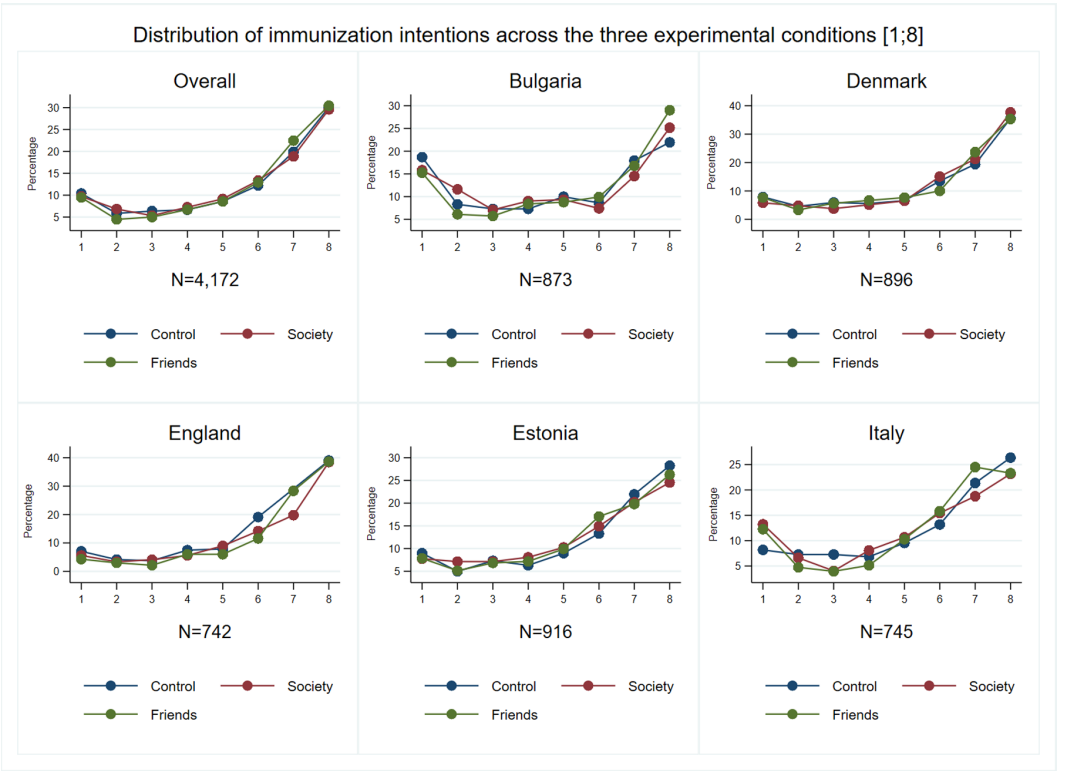

Table 1. Adjusted ordered logistic regression on immunization intentions [1;8]

	Overall		Bulgaria		Denmark		England		Estonia		Italy	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Condition												
Control	Ref.	Ref.	Ref.		Ref.		Ref.		Ref.		Ref.	
Society	1.02	0.89 - 1.16	0.98	0.74 - 1.29	1.49	1.12 - 1.98**	1.29	0.95 - 1.76	0.80	0.61 - 1.06	0.61	0.45 - 0.84**
Friends	1.13	0.99 - 1.29	1.11	0.83 - 1.48	1.15	0.87 - 1.52	1.52	1.10 - 2.10*	0.97	0.73 - 1.29	0.90	0.65 - 1.24
	4,172	873	873		896		742		916		745	

Covariates included in the regression models are country (for the overall sample), gender, age, education, employment status, health status and risk preferences. The full models can be found in the supplementary files, Table S2.

* $p<0.05$; ** $p<0.01$

conditions for the overall sample (see Table 2). Looking at the individual countries, table 3 shows that only in the case of Estonia, study participants in the *friends* condition were more likely to state that the immunization is socially important (74.7% vs 66.4%, aOR: 1.46; 95% CI: 1.01–2.09).

Table 2. Logistic regression on thinking that getting vaccinated is socially important [0;1]

Condition	Overall			Bulgaria			Denmark			England			Estland			Italy		
	(%)	OR	95% CI	(%)	OR	95% C	(%)	OR	95% CI	(%)	OR	95% CI	(%)	OR	95% CI	(%)	OR	95% CI
Control	(63.6)	Ref.		(60.1)	Ref.		(58.6)	Ref.		(66.4)	Ref.		(67.4)	Ref.		(67.3)	Ref.	
Society	(64.9)	1.06	0.90 - 1.23	(57.1)	0.89	0.64 - 1.23	(65.8)	1.39	0.99 - 1.95	(67.9)	1.08	0.74 - 1.57	(68.0)	1.03	0.73 - 1.44	(66.2)	0.89	0.60 - 1.31
Friends	(67.0)	1.16	0.99 - 1.36	(61.8)	1.09	0.77 - 1.55	(61.7)	1.14	0.81 - 1.58	(74.7)	1.48	0.99 - 2.21	(74.7)	1.46	1.01 - 2.09*	(62.5)	0.77	0.52 - 1.14
N		4,172			873			896			742			916			745	

Covariates included in the adjusted model are country (for the overall sample), gender, age, education, employment status, health status and risk preferences. The full model can be found in the supplementary files, Table S4.

* $p<0.05$; ** $p<0.01$

Effect on Expectations of Others' Behaviour

Across the five countries, the majority of study participants believed that most people would get immunized against the virus (56.3% in *control*, 55.9% in *society* and 58.5% in *friends*). The adjusted logistic regressions do not reveal any effect of the interventions on believing that most people would get vaccinated (see Table 3). Furthermore, looking at expectations within the five countries did not reveal any differences.

General Discussion

To our knowledge, this is one of the first studies to have investigated how the communication of herd immunity affects immunization intentions in a cross-country setting (Betsch et al., 2017). In an online experiment, we tested whether mentioning the social benefit of immunization for the society or friends and family influence immunization intentions. Different to previous studies, we do not find that adding information about herd immunity affects overall immunization intentions or perception of the immunization programme (Arnesen et al., 2018; Betsch et al., 2017, Böhm et al., 2019). Similar to Betsch and colleagues (2017) we found some substantial cross-country differences, suggesting that the effect is sensitive to the cultural context.

As expected by the theory of social distance, individuals in England were more likely to get immunized if they knew that the beneficiaries are close to them. While we found opposite reactions in the *society* condition for Denmark and Italy, we cannot explain these with strategic decision making in Italy as the study participants there in the *society* condition were not more likely to expect that

Table 3. Logistic regression on expectations that the majority is getting vaccinated [0;1]

Condition	Overall			Bulgaria			Denmark			England			Estland			Italy		
	(%)	OR	95% CI	(%)	OR	95% CI	(%)	OR	95% CI	(%)	OR	95% CI	(%)	OR	95% CI	(%)	OR	95% CI
Control	(56.3)	Ref.		(45.2)	Ref.		(53.6)	Ref.		(69.3)	Ref.		(51.5)	Ref.		(67.3)	Ref.	
Society	(55.9)	0.97	0.83 - 1.12	(44.2)	0.96	0.69 - 1.32	(59.3)	1.26	0.91 - 1.75	(64.2)	0.80	0.55 - 1.17	(50.6)	0.96	0.70 - 1.31	(63.6)	0.83	0.57 - 1.21
Friends	(58.5)	1.07	0.92 - 1.25	(43.5)	0.95	0.68 - 1.33	(56.7)	1.16	0.84 - 1.60	(70.4)	1.06	0.71 - 1.58	(55.3)	1.16	0.84 - 1.60	(69.2)	1.06	0.72 - 1.57
N		4,172			873			896			742			916			745	

Covariates included in the adjusted model are country (for the overall sample), gender, age, education, employment status, health status and risk preferences. The full model can be found in the supplementary files, Table S3.

* $p<0.05$; ** $p<0.01$

most people would get immunized than those in the *control* condition. In general, we did not find any evidence that the interventions influenced expectations about peer's immunization behaviour. We, therefore, conclude that the different effects on intentions to the *society* intervention were caused by alternative reasons, such as trust in the health authority (Cook, 2001). Trust may play a role in the immunization decision. Most individuals are unable to assess the quality of the work done by the health authority. For these individuals, the decision to seek immunization is thus an act of trust in the health authority (Cappelen et al., 2010.). While this suggests that in the case of Italy, participants may have perceived their health authority as less trustworthy, when the information about the immunization programme contained a paragraph on herd immunity, we do not find evidence for this in our social importance outcome variable. Participants in the *society* condition were as likely to perceive the immunization as socially important than those in the *control* condition.

LIMITATIONS OF THE EXPERIMENTAL STUDY

Our study has several limitations which call for follow-up research. Firstly, we only assessed intentions to get immunized. Therefore, the utility of communicating herd immunity in changing immunization behaviour cannot be determined from this study. According to the 'intention-behaviour gap', intention to get immunized does not necessarily translate to getting vaccinated (Sheeran, 2002; Webb & Sheeran, 2006). Thus, additional strategies may be required to build on motivational changes to increase immunization rates, such as implementation prompts (Milkman et al., 2011). Furthermore, the two binary questions on the perceived social importance and expectation of other individuals' behaviour may not have been discriminating enough to link the individual perception of the immunization programme and expectations with immunization intentions. Additionally, we used a hypothetical influenza virus for the vignettes which limits external validity. Future studies could investigate the effect of framing the beneficiaries of herd immunity in the current COVID-19 pandemic.

Finally, while we observed some effects on immunization intentions in some countries, we failed to explain them with our secondary outcome variables. Future research should include alternative variables that could explain the effect of communicating herd immunity on immunization behaviour, such as attitudes towards vaccination in general (Betsch et al., 2018).

CONCLUSION

This study tested the effect of framing the beneficiaries of herd immunity in five countries. While, across the five countries, mentioning the social benefit of immunization for the society or friends and family did not influence immunization intentions, we found some substantial cross-country differences in the effect of the two messages. Communicating the social benefit for friends and family increased intentions in England. In Denmark, however, higher immunization intentions were observed when the message mentioned the social benefit of immunization for the society. In Italy, the same message decreased immunization intentions. These contrasting effects of the messages suggest that the framing the beneficiaries of herd immunity is sensitive to the cultural context and highlight the importance of empirically testing messages beforehand. Finally, our findings have significant potential implications for the current COVID-19 pandemic. As the COVID-19 vaccination programme is the only universally acceptable way to achieve herd immunity, it is therefore important to also improve uptake of vaccine-hesitant individuals. Communicating herd immunity could improve the perceived utility of immunization and improve uptake to prevent deaths, reduce hospitalizations and accelerate the process of incrementally opening up society.

SUPPORTING INFORMATION

Additional analyses containing the full regression models can be accessed in the supporting information file.

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