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Preventive Veterinary Medicine

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https://doi.org/10.1016/j.prevetmed.2016.09.016

Preventive Veterinary Medicine 133 (2016) 114–119

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Using farmers' attitude and social pressures to design voluntary Bluetongue vaccination strategies

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ARTICLE INFO

Article history:
Received 9 May 2016
Received in revised form 9 September 2016
Accepted 15 September 2016

JEL classification:
C39
H50
Q12
Q18

Keywords:
Farmers
Decision-making
Attitude
Social pressures
Disease control
Bluetongue
Voluntary vaccination
Policy instruments

ABSTRACT

Understanding the context and drivers of farmers' decision-making is critical to designing successful voluntary disease control interventions. This study uses a questionnaire based on the Reasoned Action Approach framework to assess the determinants of farmers' intention to participate in a hypothetical reactive vaccination scheme against Bluetongue.

Results suggest that farmers' attitude and social pressures best explained intention. A mix of policy instruments can be used in a complementary way to motivate voluntary vaccination based on the finding that participation is influenced by both internal and external motivation. Next to informational and incentive-based instruments, social pressures, which stem from different type of perceived norms, can spur farmers' vaccination behaviour and serve as catalysts in voluntary vaccination schemes.

1. Introduction

Bluetongue (BT) is a World Organization for Animal Health (OIE)-listed animal disease. An outbreak of an OIE listed disease has major implications for livestock production, policy and trade in the country or region affected (Burrell, 2002). All these impacts were experienced during the Bluetongue virus serotype 8 (BTV-8) epidemic from 2006 to 2009 in the Netherlands. The virus caused clinical disease in ruminants, thereby affecting dairy as well as other farm types in cattle, sheep and goat sectors (see Elbers et al. (2008) for an overview). Financial consequences of the epidemic in 2006 and 2007 in the Netherlands have been estimated around 200 million Euros, of which about 140 million Euros relating to the dairy cow sector (Velthuis et al., 2010).

A reactive vaccination programme at transnational level was adopted in 2008 since the direct control measures and the ban of animal movements failed to stop the spread. The Dutch government offered farmers a vaccination scheme on the basis of voluntary participation with subsidy as a financial, incentive-based policy instrument. It fits in with a neoliberal governance style of cost and responsibility sharing (*e.g.* Maye et al., 2014) and is based on economic theory postulating that self-regulation may result in successful interventions at lower public cost (*e.g.* Oude Lansink, 2011). The *ex-ante* transaction costs of lobbying and legislation and *ex-post* transaction costs of surveillance and enforcement are minimized (Furubotn and Richter, 1998).

Since the implementation of the vaccination scheme, only a few Dutch farms got infected in 2008 and 2009. However, it is difficult to judge *ex-post* whether the voluntary approach was a success or a failure while many farms were already immunized via natural infection (Wilson and Mellor, 2009), which in combination with a low uptake could already be sufficient to control the spread. Actual

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http://dx.doi.org/10.1016/j.prevetmed.2016.09.016
0167-5877/

uptake by dairy farmers have been estimated at 71% in 2008 (with subsidy) (Elbers et al., 2010).

After the BTV-8 epidemic, Elbers et al. (2010), in an exploratory survey among Dutch farmers, showed that (1) prevention of production losses and (2) subsidization of vaccination were perceived as the main motives to vaccinate against BT. Other important motives mentioned were: (3) welfare concerns, (4) contribution to the eradication campaign and (5) recommendation by the practitioner.

To understand and predict individual vaccination decisions, rational choice models, *i.e.* expected utility theory (EUT) models are often applied (Hardaker and Lien, 2010; Rat-Aspert and Fourichon, 2010; Sok et al., 2014). In these models, the motives 1 and 2 are considered. It is often argued that governments should increase the expected utility (profits) by utilizing financial, incentive-based policy instruments to make voluntary disease control interventions effective.

Considering the motives 3–5 however, it might be that additional self-regulatory or motivational mechanisms exist that drive the decision to vaccinate, which cannot directly be inferred from rational choice models. Some of these mechanisms are embedded in different types of norms. Social psychological decision models emphasize the effect of social pressures on decision-making, such as the Reasoned Action Approach (RAA) (Fishbein and Ajzen, 2010). The RAA predicts that a given behaviour is determined by the strength of a person's intention to perform that behaviour. The intention is a function of three social-psychological constructs: attitude, perceived norms and perceived behavioural control. Nowadays different dimensions are captured within these constructs, also prompted through the use of multivariate statistical techniques (Thompson, 2004). Within attitude, an instrumental and experiential dimension are distinguished. Factors considered in a typical EUT model are similar to this instrumental dimension. Within perceived norm, an injunctive and descriptive dimension are distinguished. Within perceived behavioural control, a capacity and an autonomy dimension are distinguished (see Fishbein and Ajzen (2010) for an overview). In this study, only the construct of perceived norms is disentangled into an injunctive and descriptive dimension to investigate in more detail the social pressures operating on farmers.

Next to information and incentive-based instruments is the effectiveness of disease control interventions also dependent on reflecting, re-enforcing and shaping attitudes and norms within a community (Collier et al., 2010). Therefore an understanding of which of these constructs drive farmers' compliance with a policy intervention is critical for an efficient and effective design. The aim of this research is to assess which of the socio-psychological constructs and underlying dimensions drive farmers' intention to participate in a hypothetical reactive vaccination scheme against BT.

2. Material and methods

2.1. Framework and statistical method

The RAA model identifies the social-psychological constructs that may influence intention to carry out particular behaviours, so that statistical modelling can be used to estimate the nature and significance of these relationships.

The model can mathematically be represented as follows:

$$B \sim I = f(A, PN, PBC), \quad (1)$$

$$\text{where} \quad PN = f(N_I, N_D), \quad (2)$$

B given behaviour
I intention to perform the behaviour
A attitude – the farmer's positive or negative evaluation of performing that behaviour
PN perceived norms – the social pressures one feels to perform that behaviour
N_I injunctive norm – the perceptions of what referents think he or she should do
N_D descriptive norm – the perceived behaviour of others (farmers)
PBC perceived behavioural control – the perceived own capability to perform that behaviour.

In this study, structural equation modelling (SEM) was used to estimate the entire RAA as a set of simultaneous equations. It models correlational and causal relationships among constructs and corrects for measurement errors of the observed variables that represent these constructs in the estimation procedure. A construct is a latent variable that can be defined in conceptual terms but cannot directly be measured or be measured without error. Therefore, a construct is represented by multiple variables that, in combination, give a reasonably accurate measure of the construct using factor analytic approaches (Hair et al., 2010).

The commonly applied two-step modelling approach in SEM, developed by Anderson and Gerbing (1988), was used. First step was to estimate a measurement model in which the variables were assigned to their constructs, using confirmatory factor analysis. Thus, based on the RAA model, it was *a priori* specified which variables make up which of the five constructs. Based on tests assessing the score reliability, score validity and overall model fit (*e.g.* see Fornell and Larcker, 1981), the measurement model was evaluated on its specification and consistency with the data. The second step was to estimate a structural model in which the causal relationships were tested to investigate the impact of the exogenous constructs attitude, injunctive norm, descriptive norm and perceived behavioural control on the endogenous construct intention. As constructs are often highly correlated, different model specifications were run to assess the presence of multicollinearity.

2.2. Questionnaire and sample

In Table 1 a description of the variables measured is given, with these elements being based on the standard questionnaire format provided by Fishbein and Ajzen (2010). In defining the action that respondents were to undertake (or rather, express their intention to undertake) Ajzen's TACT principle has been used, with actions defined in terms of target, action, context and time. For example, 'If Bluetongue (target) were to occur in the environment (context) this year (time), and a voluntary vaccination programme was to be announced (context), I am going to vaccinate my herd preventively (action). All questions were preceded with the phrase: "If Bluetongue were to occur in the environment this year", and for the questions related to the constructs perceived behavioural control and intention the words "and a voluntary vaccination programme was to be announced" were added to emphasize the voluntary nature of the vaccination scheme.

A 5-points semantic differential scale with five different bipolar adjective pairs (*e.g.* unsatisfying and satisfying) was used to measure attitude. The other variables were measured with 5-point bipolar Likert-type scales with endpoints "disagree" to 'agree'.

A random sample of 1500 Dutch dairy farms was drawn from the National Cattle Identification and Registration Database. The sample was restricted to farms with a herd size of at least 40 dairy cows, which is about 80 to 85% of the whole dairy farm population (LEI, 2016). These are more likely to be professional dairy farmers rather than hobby farmers. The latter type of farmers were excluded because it was felt that their decision-making process for vaccination decisions, in the face of a threat of a BT infection, could be made in a very different decision context (*e.g.* Gethmann et al., 2015).

Table 1
Description of the variables for representing the constructs in the SEM.

Construct and variable		Description of the statement	
Attitude	a_1	Preventive vaccination of my herd is . . .	. . . unsatisfying – satisfying[a]
	a_2		. . . disadvantageous – advantageous[b,*]
	a_3		. . . necessary – unnecessary[b]
	a_4		. . . unimportant – important[b]
	a_5		. . . acceptable – unacceptable[a,*]
Injunctive norm	ni_1	People who have something to do with my farm expect me to vaccinate my herd preventively.	
	ni_2	People in the industry whose opinions I value would approve of me vaccinating my herd preventively.	
	ni_3	People who are important to me think that I should vaccinate my herd preventively.	
Descriptive norm	nd_1	Farmers like me are going to vaccinate their herd preventively.	
Perceived (beh.) control	pbc_1	I do have the possibility to vaccine my herd preventively.[c]	
	pbc_2	I could vaccinate my herd preventively, if I wanted to.[c]	
	pbc_3	It is up to me whether I vaccinate my herd preventively.[d]	
Intention	i_1	I am going to vaccinate my herd preventively.	
	i_2	I do want to vaccinate my herd preventively.	
	i_3	I am willing to vaccinate my herd preventively.	

[a] Experiential dimension.
[b] Instrumental dimension.
[c] Capacity dimension.
[d] Autonomy dimension.
[*] These variables were reversely recoded for the statistical analysis.

The questionnaire[1] was pre-tested on two dairy farmers. The final, revised, questionnaire was sent out in January 2014, along with a pre-paid return envelope and an accompanying letter in which the relevance of the research was set out. Farmers were offered two possibilities to fill in the questionnaire: using the paper copy, or on-line. The letter ended with a guarantee of anonymity of responses and the offer of a financial incentive to take part: *i.e.* a 10% chance of winning a gift coupon of € 25. After 4 weeks, a reminder was sent to all farmers in the sample. The final response, the 415th, was returned March, resulting in a response rate of 28 percent. About one sixth of the returned questionnaires were filled out on-line. Observations with missing values were excluded from the statistical analysis, resulting in an effective sample size of 357.

3. Results

3.1. Descriptive statistics

Regarding respondents' attitude, mean rank scores of the observed variables (a_1– a_5) indicated a fairly positive evaluation of the outcomes of the behaviour (3.57–3.86) (Table 2). Correlations among variables for attitude were high (all within-construct correlations are marked bold). Correlations between variables for attitude and intention were also high.

Regarding respondents' perceived norms, mean rank scores of the variables were around average (2.99–3.43). Correlations among variables for injunctive norm were high. The variable ni_2 based on the question "people in the industry whose opinion I value" had the highest mean rank but at the same time was only weakly correlated with the intention variables. The other two variables for injunctive norm correlated highly with those of intention, attitude and descriptive norm.

Regarding respondents perceived behavioural control, mean rank scores of the variables were just below or above 4 (3.95–4.18). The scores indicated that, on average, farmers were capable of performing vaccination against BT. The variable pbc_3, representing the autonomy dimension within perceived behavioural control, had the highest rank (4.18) but had modest correlations with the other variables within perceived behavioural control and at the same time was not correlated with all other variables, including those of intention.

Regarding respondents' intention, mean rank scores were slightly above average (3.11–3.43). The variable i_3 had the highest score (3.43), most likely because the phrase used – I'm willing to – was the least powerful expression to measure intention. Correlations among variables for intention were very high.

Correlations among observed variables for each construct were internally consistent given the $\propto_C$ values (Table 2). The $\propto_C$ for the constructs attitude and intention were "excellent", for injunctive norm "very good" and for perceived behavioural control "adequate" (Kline, 2011). For descriptive norm there was only one observed variable, hence the score reliability cannot be calculated for this construct.

3.2. SEM estimations

The evaluation of the measurement model resulted in a respecification. The main issue here was that the variable pbc_3 (representing the autonomy dimension) was removed from the model because of low score validity, and thus only the capacity dimension remained with perceived behavioural control.

Fig. 1 shows the estimated causal relationships, the extent to which the exogenous constructs attitude, injunctive norm, descriptive norm and perceived behavioural control impact upon the endogenous construct intention. All exogenous constructs inserted were allowed to correlate. The highest causal relationship was that of attitude on intention, while holding all other constructs constant. These results at first sight suggest that, for the vaccination behaviour, attitude is the main determinant of intention.

Given the discrepancy between beta's on and intercorrelations between constructs, results also suggested shared variance (multicollinearity) being present among exogenous constructs. Table 3 reports on different model specifications that were run to show where the multicollinearity was present. The main source of collinearity was found between the constructs attitude and injunctive norm when explaining intention. In model specifications A and B, the beta's of both constructs were separately estimated, while in model specification C they were jointly estimated. In the latter specification, the beta of injunctive norm got a much lower regression

[1] The questionnaire is available upon request.

Table 2
Sample correlation matrix with means, standard deviations of the variables and Cronbach's alpha values of the constructs.

Variable		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	$\propto_C$
1.	a_1	1															0.90
2.	a_2	**0.72**	1														
3.	a_3	**0.67**	**0.59**	1													
4.	a_4	**0.76**	**0.69**	**0.81**	1												
5.	a_5	**0.59**	**0.49**	**0.58**	**0.59**	1											
6.	ni_1	0.43	0.43	0.46	0.48	0.36	1										0.80
7.	ni_2	0.23	0.27	0.27	0.30	0.39	**0.58**	1									
8.	ni_3	0.41	0.40	0.45	0.48	0.39	**0.65**	**0.49**	1								
9.	nd_1	0.30	0.26	0.21	0.28	0.25	0.44	0.26	0.33	1							–
10.	pbc_1	0.24	0.27	0.21	0.29	0.35	0.20	0.29	0.19	0.04	1						0.73
11.	pbc_2	0.27	0.30	0.23	0.29	0.32	0.16	0.23	0.20	0.09	**0.75**	1					
12.	pbc_3	−0.08	0.00	0.00	0.00	0.04	0.00	0.01	0.00	−0.05	**0.35**	**0.31**	1				
13.	i_1	0.66	0.56	0.58	0.68	0.51	0.50	0.26	0.51	0.35	0.29	0.28	0.02	1			0.94
14.	i_2	0.64	0.54	0.58	0.65	0.51	0.51	0.28	0.50	0.35	0.30	0.30	0.03	**0.92**	1		
15.	i_3	0.60	0.54	0.57	0.61	0.58	0.45	0.32	0.48	0.31	0.31	0.31	0.02	**0.81**	**0.81**	1	
Mean		3.64	3.57	3.57	3.75	3.86	2.99	3.43	3.03	3.27	3.95	4.08	4.18	3.22	3.11	3.43	
Std. Error		1.13	1.02	1.12	1.08	1.06	1.24	1.16	1.18	1.00	0.99	0.95	1.04	1.26	1.24	1.22	

Within-construct correlations are marked bold.
$\propto_C$ = Cronbach's alpha, and calculated as $n\bar{r}/1+(n-1)\bar{r}$, where n is the number of observed variables and $\bar{r}$ is the average correlation between all pairs of observed variables for one construct.

Table 3
Different structural model specifications to show the presence of multicollinearity among constructs.

Model spec.	Exogenous constructs inserted	Beta estimates of:				R^2
		1. Attitude	2. Injunctive norm	3. Descriptive norm	4. Perceived beh. control	
A	1.	0.77				0.59
B	2.		0.61			0.37
C	1. and 2.	0.62	0.23			0.62
D	3.			0.38		0.14
E	2. and 3.		0.56	0.10		0.37
F	4.				0.37	0.13
G	1., 2., 3. and 4.	0.61	0.18	0.09	0.08	0.65

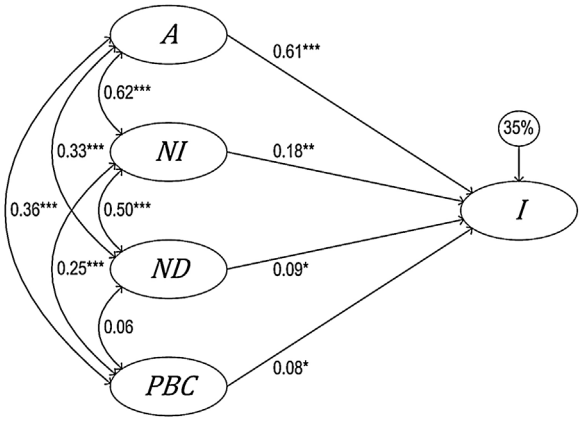

Fig. 1. Structural model estimation, where an ellipse represents a construct, a circle an error term, a straight arrow a dependence relationship and a curved arrow a correlational relationship. The number of asterisks denote the significance level where ***, ** and * are at 0.001 (highly), 0.01 (moderately) and 0.10 (somewhat) respectively.

weight due to the high correlation with attitude. Therefore, in addition to attitude, injunctive norm was an important determinant of intention.

A smaller source of collinearity was found between both normative constructs when explaining intention. In model specifications B and D, the beta's of both normative constructs were separately estimated, while in model specification E they were jointly estimated. In the latter specification, the beta of descriptive norm got a much lower regression weight due to the high correlation with injunctive norm. Therefore, in addition to injunctive norm also descriptive norm had some impact upon intention. Or put differently, within the perceived norm construct, injunctive norm was more important than descriptive norm.

4. Discussion

Results of this study suggest that attitudinal considerations outweigh normative and control considerations as causal factors influencing intention to vaccinate against BT. Thus, farmers who exhibited a positive intention to vaccinate evaluated that behaviour positively, and vice versa. Although attitude turned out to be the main determinant of intention, results indicated that social pressures influenced intention formation as well.

Three main types of policy instruments are commonly distinguished: financial, incentive-based (*carrots*), regulative (*sticks*), and informational (*promises* or *sermons*) instruments (Rothschild, 1999; Bemelmans-Videc et al., 2011). Traditionally, the focus has been on financial and regulative instruments (Collier et al., 2010). The first and third type of policy instrument can be used to motivate voluntary participation where carrots are 'external motivators' and promises 'internal motivators'. Both these instruments were used in the past BT vaccination strategy in 2008 (Ministry of Economic Affairs, 2008).

Since attitude is the main determinant of intention and farmers, on average, expressed a fairly positive evaluation of the outcomes of the behaviour, an obvious type of policy instrument to stimu-

late the vaccination uptake are informational instruments that can increase the internal motivation by reasoned opinions. One should consider that information is more likely accepted if there is a credible communicator, a high level of 'similarity' between the audience and communicator and both the message and communicator must be perceived as trustworthy (Petty and Cacioppo, 1996).

Subsidization as a financial, incentive-based instrument, is an external motivator to encourage participation by making herd vaccination cheaper. Its effect on farmers' vaccination behaviour can be heterogeneous as different crowding effects can occur. Subsidization can strengthen (crowding-in) but also weaken (crowding-out) the internal motivation (Frey, 1993; Deci et al., 1999) and norms that induce behaviour externally (Bowles and Polanía-Reyes, 2012; Kuhfuss et al., 2015). It is important to take into account that different groups of farmers base their participation decisions on different considerations, and therefore a mix of instruments is required to maximize the uptake (Barnes et al., 2015).

The model of individual decision-making utilized in this paper originates from social psychology and is not a rational choice model. The RAA gives more weight to social aspects of decision-making.

Results show that, for the BT vaccination decision problem, farmers' decision-making is affected by social pressures. Thus, farmers in this respect do not act as autonomous actors who can be encouraged to participate only by providing information or incentives, but they are influenced by what referents think (injunctive norm) and what the expected behaviour of other farmers will be (descriptive norm).

Given that these social interactions among farmers and other referents about vaccination decisions exist, motivational mechanisms, such as peer group pressure, can be actively used as a fourth type of policy instrument to motivate participation (Leeuwis, 2007; Collier et al., 2010). Social pressures might take the role of a 'catalyst' among the mix of policy instruments used in BT vaccination strategies based on voluntary participation, and leverage the (cost-)effectiveness and efficiency of such interventions.

Intervention design can be further supported by empirically analyzing the indirect measures, *i.e.* looking at which underlying beliefs explain each construct (Sok et al., 2015). Studying indirect measures is very relevant as they can help understanding what exactly drives the behaviour (Montaño and Kasprzyk, 2008). Attitudinal and normative beliefs are of most interest since this analysis showed that the behaviour is driven by attitudinal considerations and injunctive and to a lesser extent descriptive norms. Moreover, the heterogeneity in farmers' beliefs can be mapped out with behavioural concepts, such as perceived risk and personality traits, and with differences in farming structures (Sok et al., 2016).

In conclusion, it has been shown that farmers' attitude and social pressures best explained intention to vaccinate against BT. Informational policy instruments are used for motivating farmers' whose attitude is favourable; they can be motivated internally by reasoned opinions. Incentive-based policy instruments are used for motivating farmers externally by financial compensation. The effect of these subsidies on vaccination behaviour is likely heterogeneous and for each farmer not necessarily positive. Next to informational and incentive-based instruments, social pressures, which stem from different type of perceived norms, can spur farmers' vaccination behaviour and serve as catalysts in voluntary vaccination schemes.

Acknowledgments

This research was funded by the Ministry of Economic Affairs (Netherlands Food and Consumer Products Safety Authority) of the Netherlands via EMIDA ERA-NET "Coordination of European Research on Emerging and Major Infectious Diseases of Livestock" (funded by the European Commission's Seventh Framework Programme, Project No. 219235).

The authors would like to thank Ivo van der Lans for his valuable input to the statistical analysis, Philip Jones for his valuable comments to the manuscript and three anonymous reviewers for their comments.

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