Journal of Community & Applied Social Psychology
J. Community Appl. Soc. Psychol., **24**: 359–375 (2014)
Published online 4 November 2013 in Wiley Online Library
(wileyonlinelibrary.com) **DOI**: 10.1002/casp.2170

Fundamental Beliefs, Origin Explanations and Perceived Effectiveness of Protection Measures: Exploring Laypersons' Chains of Reasoning About Influenza

VÉRONIQUE EICHER[1]*, ALAIN CLÉMENCE[1], ADRIAN BANGERTER[2], AUDREY MOUTON[3], EVA G. T. GREEN[3] and INGRID GILLES[3]
[1]*NCCR LIVES, University of Lausanne, Lausanne, Switzerland*
[2]*University of Neuchâtel, Neuchatel, Switzerland*
[3]*University of Lausanne, Lausanne, Switzerland*

ABSTRACT

Laypersons' chains of reasoning in explaining recent influenza outbreaks are investigated. Drawing on social representations theory, fundamental worldviews, that is, the belief in a dangerous world (BDW), are postulated to anchor explanations of disease origins, which in turn affect perceived effectiveness of protection measures. Our study, based on a longitudinal survey among the general public in Switzerland, showed that the lower people's BDW scores, the more they appeal to natural origins to explain outbreaks and the more they perceive official protection measures as effective. The higher people's BDW scores, the more they explain outbreaks via hygienic origins, which are linked with out-group discrimination measures, and conspiracy origins, which are linked with lower perceived effectiveness of aid intervention measures. Copyright © 2013 John Wiley & Sons, Ltd.

Key words: social representations; H5N1; H1N1; protection measures; chains of reasoning

Although the success of public health measures during outbreaks of infectious diseases hinges on the degree to which people follow appropriate protection measures, many people do not follow them: during the recent H1N1 pandemic, vaccination compliance was low in many countries such as the USA (12.9–38.8% per state; CDC, 2010) or Switzerland (8–30% per canton; Swiss Federal Office of Public Health, 2010). Why do some people follow recommended protection measures while others do not? Researchers have suggested investigating how people reason about scientific and medical theories and the context in which they perform this reasoning (e.g. Bauer, 1998; Radley & Billig, 1996;

*Correspondence to: Véronique Eicher, NCCR LIVES, University of Lausanne, Bâtiment Géopolis CH-1015 Lausanne, Switzerland.
E-mail: veronique.eicher@unil.ch

 Accepted 9 October 2013

Wagner, 2007). On the basis of social representations theory (SRT), this approach posits that people try to understand unfamiliar diseases by framing them according to pre-existing knowledge (Moscovici, 2000). Consequently, they elaborate *chains of reasoning*, which may be inconsistent with expert discourse and recommendations (e.g. Echebarria Echabe, Guede, Sanjuan Guillen, & Valencia Garate, 1992; Joffe & Staerklé, 2007). Here, we analyse social representations about the origins and effectiveness of protection measures in the context of H1N1 (swine flu) and H5N1 (avian flu). We suggest that people follow different chains of reasoning that connect the disease origins with protection measures depending on the extent to which they believe the world is dangerous.

Making sense of novel events according to social representations theory

According to SRT (Bauer & Gaskell, 1999; Moscovici, 1961; Wagner & Hayes, 2005), suddenly occurring novel events such as disease outbreaks are symbolically and materially threatening. Laypersons make sense of these events by generating explanations that place them within a familiar frame of reference. Such sense-making involves two processes: anchoring and objectification. In objectification, new concepts are associated with concrete symbols and images, thus making them easier to visualize and communicate. In anchoring, new information is interpreted according to older knowledge and beliefs. It is through objectification and anchoring that the content of knowledge gets transformed, in particular from scientific theory into common sense (Bangerter & Heath, 2004; Green & Clémence, 2008).

Although objectification and anchoring lead to the emergence of social representations that facilitate making sense of novel events in everyday life, all individuals do not necessarily share these representations. People may differ in their prior knowledge about events or in their endorsement of particular beliefs. These differences serve as organizing principles that give rise to diverging social representations (Doise, 1993) and structure them into different chains of reasoning (Doise, Clémence, & Lorenzi-Cioldi, 1993). Organizing principles define different ways of thinking by articulating objectification, which allows people to share common knowledge, and anchoring, which leads to differences because people do not have the same initial knowledge and beliefs. Chains of reasoning are thus based on fundamental worldviews about the functioning of society (such as feeling safe or in danger) and developed by the association of entities perceived as responsible for the disease (e.g. danger coming from out-groups) and the means to cope not only with the disease but also its origins. These worldviews intervene in the familiarization of new information, and because people adopt different positions towards them, worldviews offer different anchoring points for the development of chains of reasoning from initial information. Investigating chains of reasoning from an SRT perspective thus allows moving beyond the deficit model (e.g. Wynne, 1991) and rational risk perception (e.g. Champion & Skinner, 2008) in diseases to explain why some people choose to follow protection measures while others do not.

One worldview relevant for the domain of diseases is the perception of the environment as more or less dangerous. Indeed, with the appearance of new emerging infectious diseases (e.g. HIV/AIDS) and accidents (e.g. nuclear disasters), people seem divided on the question of how safe the world is. The *belief in a dangerous world* (BDW; Altemeyer, 1988; Duckitt, Wagner, du Plessis, & Birum, 2002) is a construct reflecting this basic ideological orientation in life. Low scores on this construct reflect the belief that the world is safe and that people are fundamentally good with the best of intentions, whereas high

DOI: 10.1002/casp

scores indicate beliefs of a world that is dangerous and full of people with bad intentions (Duckitt et al., 2002). Consequently, high BDW should be associated with the tendency to explain disease outbreaks as caused by humans, either intentionally or unintentionally. In a chain of reasoning, whether people see the world as dangerous or not should thus affect origin explanations of infectious diseases.

Lay explanations of origins of infectious diseases

The SRT framework has been applied to study social representations of new threats such as emerging infectious diseases (e.g. Gilles et al., 2013; Green et al., 2010; Joffe, 1999; Washer, 2006, 2010; Washer & Joffe, 2006) and, more specifically, laypersons' reasoning about disease origins (e.g. Joffe & Lee, 2004; Liao et al., 2009).

Interviews on representations of H5N1 with people in Hong Kong (Joffe & Lee, 2004) and South and East Asia (Liao et al., 2009) showed different types of origin explanations: the weather, pollution, new technologies and politics; unhygienic practices of chicken rearers and overcrowding; and viruses (e.g. new strains of older diseases). In a study of social representations of H1N1 in Turkey (Gul Cirhinlioglu & Cirhinlioglu, 2010), a sixth of the respondents perceived H1N1 to be human-made (e.g. developed as a biological weapon), whereas a third saw H1N1 as a form of the common flu.

Lay explanations of infectious disease thus broadly appeal to two kinds of origins. A *natural* origin explanation is derived from modern medical science. It is the dominant explanation for infectious diseases in modern societies and constitutes the foundation for disease prevention programmes advocated by political authorities. Explanations attributing disease outbreaks to the emergence of new viral or bacterial strains fall into this category. Another kind of explanation appeals to actions of *humans*. For instance, in the Middle Ages, different diseases were attributed to Jews poisoning wells (Campion-Vincent, 1989). Despite the advent of modern medical science, versions of this explanation remain alive. Examples include blaming outbreaks on unhygienic practices of out-groups (e.g. chicken rearers, Joffe & Lee, 2004; gay men in the case of AIDS, Washer, 2010) or on plots by terrorists or governments, in line with conspiracy theories (e.g. AIDS as an instrument of genocide created by the US government to exterminate minority populations, Ross, Essien, & Torres, 2006).

This latter type of explanation cannot be reduced to lack of scientific knowledge. Laypersons often master basic scientific knowledge (Lorenzi-Cioldi & Clémence, 2001; Wagner, 2007), but this does not tell them why a particular disease emerges or who is responsible for it. To compensate for this uncertainty, they make inferences from their initial worldviews to explain the disease origins. These worldviews intervene as organizing principles that structure social representations from shared meanings to various chains of reasoning (Doise et al., 1993). When social groups vary in their organizing principles, new information triggers more debate, resulting in diffusion and transformation of this information. One such worldview is BDW, which is associated with belief in conspiracy theories (Wagner-Egger & Bangerter, 2007) and exclusionary immigration attitudes (e.g. Green et al., 2010). In chains of reasoning, BDW should thus be linked to explanations of disease origins: we expect people who see the world as dangerous to be more likely to view disease outbreaks as having their origins in human actions, whereas participants who see the world as safe should be more likely to believe the natural origin explanation propagated by medical authorities. The origin explanations in turn will affect perceived

DOI: 10.1002/casp

effectiveness of different protection measures. The initial worldview thus anchors different chains of reasoning, which explains why different people endorse different protection measures (e.g. vaccination).

From origin explanations to protection measures

Research on predictors of protection behaviour has mostly been guided by theories of health behaviour, such as the health belief model (Champion & Skinner, 2008) or the theory of planned behaviour (Montano & Kasprzyk, 2008), in which risk perception plays a major role. For instance, in the case of H1N1, anxiety influences protection behaviours such as vaccination, avoidance and hygienic behaviour (e.g. Jones & Salathé, 2009; Liao, Cowling, Lam, & Fielding, 2010; Rubin, Amlot, Page, & Wessely, 2009; Setbon & Raude, 2010).

There is less research on the link between disease explanations and perceived effectiveness of protection measures. However, belief in conspiracy theories about the origin of HIV influences several outcome measures: people who believe in conspiracy theories use less condoms (e.g. Ross et al., 2006), show lower adherence to therapy (e.g. Whetten et al., 2006) and know less about HIV risk and prevention (e.g. Kalichman & Simbayi, 2004).

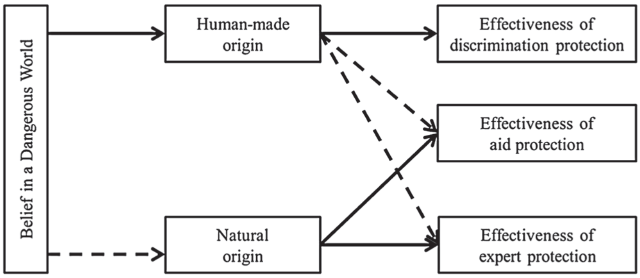
As these studies highlight the consequences of conspiracy beliefs for protective behaviour, it is likely that natural and human-made origin explanations will also influence protective behaviours. Whereas the first link in the chain of reasoning regarding infectious diseases relates BDW to origin explanations, the second link relates these explanations to protective behaviours. If people perceive a disease to be due to natural causes, we expect them to endorse *expert-recommended* and *aid intervention* measures to a stronger degree than those who locate origins in the actions of humans. Both measures are in line with a scientific point of view about the natural cause of the disease and are propagated by institutions such as the World Health Organization (WHO, 2010). People explaining a disease with the lack of hygiene or morality in other groups, however, will be more likely to engage in *discrimination* measures (e.g. Schaller, Park, & Faulkner, 2003), such as avoiding out-group members. They should also reject officially recommended protection measures (i.e. expert-recommended and aid interventions) as these are closely associated with the officially propagated cause of the disease.

We analyse these chains of reasoning, starting from individual differences in the BDW, leading to origin explanations, to perceived effectiveness of protection measures. We investigate these chains longitudinally over 1 year to analyse their stability. If, as we assume, the chains are anchored in the fundamental BDW, they should be relatively stable over time. Figure 1 outlines the chains of reasoning we expect to find.

CURRENT STUDY

In the current study, we investigate a social representational model of the variations in attitudes towards protection measures in the context of the H5N1 and H1N1 outbreaks in Switzerland. The most recent strain of H5N1 was first documented in 1997, and although the occurrences in Europe were limited to animals, more than 350 people have died in several Asian countries as of 12 March 2013 (WHO, 2012). First cases of H1N1 were reported in March/April of 2009, and in June 2009, WHO raised the pandemic alert level to phase 6 (i.e. the highest level possible), thereby declaring the first influenza

DOI: 10.1002/casp



Note. Dashed lines represent negative associations

Figure 1. Schematic representation of chains of reasoning.

pandemic of the 21st century. In spring 2009, we were conducting the first wave of a longitudinal survey on lay explanations about the origin of H5N1. As the initial outbreak of H1N1 occurred during this first wave, we decided to focus the *second* wave of data collection—in spring 2010—on *both* H5N1 *and* H1N1 (half of the participants in Wave 2 were asked about H5N1, and half were asked about H1N1). This longitudinal design enabled us to study the stability of chains of reasoning across two time points and to control for potential differences in perceptions of the two strains of influenza. The possibility to study the stability of chains over two types of influenza is especially interesting as it shows whether representations are distinctive for each type of influenza or similar across the two diseases with different mortality rate. As we assume that the chains are anchored in previous fundamental beliefs, we expect them to be quite similar even across diseases.

The three components of the chain of reasoning were measured as follows. First, we assessed participants' ideological worldview (i.e. BDW; Duckitt et al., 2002) that we expect to organize origin explanations of the disease. Then, we measured the previously described types of origin explanations. The natural origin is the cause propagated by scientific authorities and the mainstream media and can thus be seen as 'official version'. The *human-made* origin refers to lack of hygiene or morality in other groups, thus focusing blame on them. These groups may be minority or foreign out-groups or powerful elites (e.g. the pharmaceutical industry) who are intentionally or unintentionally responsible for the disease. Finally, we assessed beliefs in the effectiveness of three categories of protection measures described previously: official expert-recommended protection measures, discrimination measures targeting out-groups and aid intervention measures.

We used structural equation modelling to test the hypothesized model of different chains of reasoning.

METHOD

Participants

We conducted a two-wave longitudinal survey in French-speaking Switzerland. For Wave 1, 2400 adults were contacted between March and June 2009. They were randomly selected from a large database of addresses according to gender, age (18–39, 40–65 and older than 65 years) and residential area (rural versus urban). One year later, between March and June 2010, all of the respondents of Wave 1 ($N = 951$, response rate = 40% for Wave 1) were contacted and asked to complete a similar survey. As the initial outbreak of pandemic (H1N1) occurred during Wave 1, we asked half of the participants at Wave 2 to complete the questionnaire on H5N1 (hereafter *H5N1/H5N1 group*) and the other half to complete the questionnaire on H1N1 (hereafter *H5N1/H1N1 group*). Respondents received a small monetary reward for participation. Our final sample included 606 participants (response rate = 64% for Wave 2), 309 participants in the H5N1/H5N1 group and 297 participants in the H5N1/H1N1 group (those who only responded in Wave 1 were omitted from the sample). Demographic characteristics (i.e. gender, age, education, citizenship and marital status) did not vary between groups and were similar to the general population of Switzerland with the exception of residential area (Gilles et al., 2011). The H5N1/H5N1 group included 174 women [56%, age: $M = 45.99$, standard deviation (SD) = 15.40] and 135 men (age: $M = 46.40$, $SD = 16.40$). The H5N1/H1N1 group included 170 women (57%, age: $M = 46.13$, $SD = 16.04$) and 127 men (age: $M = 46.42$, $SD = 15.43$).

Measures

All variables were measured at Waves 1 and 2 (i.e. in 2009 and 2010). We used structural equation modelling including latent variables. Cronbach's alpha for most constructs was above .70, with the exception of natural origin and expert-recommended measures (Table 1). As we did not create scores from the individual items, these lower Cronbach's alphas do not affect our analyses. We performed confirmatory factor analyses (CFAs) to test the structure of the latent constructs and to test for equivalence of these constructs across the two waves (by constraining the factor loadings to be equal across waves). All constructs were tested separately for the two groups (H5N1/H5N1 and H5N1/H1N1).

Belief in a dangerous world. The scale was developed by Duckitt et al. (2002) and originally included 10 items. A pre-tested six-item measure, adapted to the Swiss context, had a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). An example item is *There are many dangerous people in our society who will attack someone out of pure meanness, for no reason at all.* Model fit indices of the CFAs with equal loadings were good for both groups [comparative fit indices (CFIs) ≥ 0.98, root mean squared errors of approximation ($RMSEA$s) ≤ 0.054 and standardized root mean square residuals ($SRMR$s) ≤ 0.044].

Origin explanations. Respondents evaluated the likelihood of five statements about origins of the H5N1 (or H1N1) virus on a 5-point scale from 1 (*not at all likely*) to 5 (*very likely*). The hypothesized two-factor structure (natural vs human-made origin) could not be confirmed by CFAs: although model fit indices were satisfactory with two factors (CFIs ≥ 0.95, $RMSEA$s ≤ 0.068 and $SRMR$s ≤ 0.089), the factor loading of the unhygienic out-group item to the human-made origin was too low in both waves and groups ($\beta \leq .08$ in all groups and waves). We therefore decided to split the human-made origin factor into two factors, resulting in similar fit indices (CFIs ≥ 0.96, $RMSEA$s ≤ 0.068 and $SRMR$s ≤ 0.090) and good factor loadings: the three resulting factors are (i) natural origin, which is based on two items (*the virus mutated from earlier strains of influenza* and *the origin of the virus is natural*); (ii) conspiracy origin of disease, also based on two items (*the virus was created and spread systematically by some governments* and *the virus was created by the pharmaceutical industry to sell more medicaments*); and (iii) unhygienic out-group origin, which is based on one item (*the virus developed because of the lack of hygiene present in some countries*).

DOI: 10.1002/casp

Table 1. Means, standard deviations and Cronbach's alphas for all variables for the groups H5N1/H5N1 and H5N1/H1N1

	H5N1/H5N1 group				H5N1/H1N1 group			
	Wave 1		Wave 2		Wave 1		Wave 2	
	M (*SD*)	α	*M* (*SD*)	α	*M* (*SD*)	α	*M* (*SD*)	α
BDW	3.20 (0.86)	.82	3.22 (0.88)	.84	3.33 (0.86)	.84	3.30 (0.86)	.83
Unhygienic out-group origin	3.90 (1.04)	NA	3.74 (1.06)	NA	3.78 (1.09)	NA	3.55 (1.13)	NA
Conspiracy origin	1.95 (0.99)	.82	2.20 (1.01)	.78	2.13 (1.00)	.76	2.43 (1.14)	.81
Natural origin	3.30 (1.02)	.71	3.35 (0.92)	.62	3.19 (0.99)	.57	3.20 (0.95)	.65
Discrimination	1.87 (0.94)	.88	2.09 (0.92)	.91	2.00 (1.03)	.95	2.12 (0.96)	.91
Aid	4.14 (0.81)	.69	3.84 (0.89)	.72	4.04 (0.92)	.78	3.65 (0.96)	.69
Expert	2.77 (0.95)	.65	3.23 (0.93)	.70	2.81 (0.96)	0.64	3.27 (0.93)	.73
N	305				295			

Note: BDW, belief in a dangerous world; SD, standard deviation; NA, not applicable.

DOI: 10.1002/casp

Protection measures. Respondents were asked to evaluate the effectiveness of protection measures against H5N1 (or H1N1) on a 5-point scale from 1 (*not at all effective*) to 5 (*very effective*). We focused on three protection measures relevant to origin explanations: expert-recommended protection measures were based on three items (*avoid crowds*, *avoid shaking hands* and *wear a mask*), discrimination measures targeting out-groups were based on two items (*avoid contact with people from foreign countries* and *avoid contact with foreign businessmen*) and aid-based intervention measures were based on two items (*financially support medical research and prevention* and *help the countries most affected by the disease*). Model fit indices of the CFAs were satisfactory (CFIs ≥ 0.95, $RMSEA$s ≤ 0.060 and $SRMR$s ≤ 0.081).

RESULTS

Description of statistical analyses

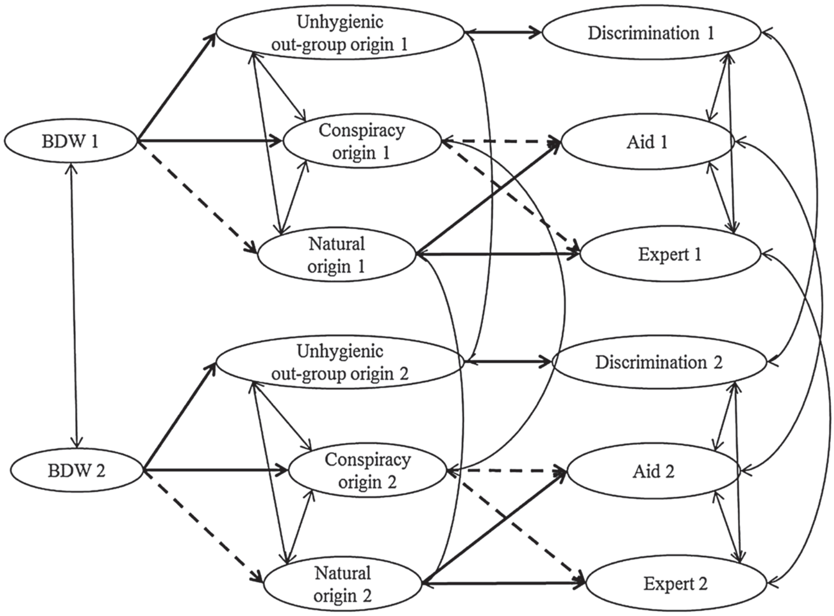
We analysed our model separately for the two groups, starting with the H5N1/H5N1 group and replicating the analyses with the H5N1/H1N1 group. The separate analyses allowed us to test our hypothesized model on two distinct samples and two types of influenza. As the two-factor structure for origin explanations could not be confirmed, we adapted our model to include three origin explanations. As the human-made origin explanation was now divided into two subcategories (conspiracy origin and unhygienic out-group origin), we adapted our predictions concerning the links between origins and protection measures: We expected people who endorse the unhygienic out-group origin to believe discrimination protection measures to be most effective (avoiding people who are seen to be causing the disease), whereas we expected people believing in a conspiracy origin to see aid and expert-recommended measures to be ineffective (if the official version regarding the origin is rejected, associated protection measures recommended by authorities should also be rejected). The adapted model can be seen in Figure 2. We included all variables from Waves 1 to 2 and correlated all variables and constructs between Waves 1 and 2 (i.e. controlling for the fact that the same people answered in both Waves 1 and 2). In the first step, we let the paths of both waves vary freely (but constrained item loadings to be equal to ensure equivalence of constructs across waves). In the second step, we constrained all paths to be equal between Waves 1 and 2, thus allowing a direct comparison of the strength of effects between waves. The analysed model included the measurement model (i.e. items were included as indicators of latent factors), but for reasons of clarity, only the hypothesized structural model is shown in Figure 2. To control for socio-demographic variables, we included gender, age and education level as predictors of BDW, but again for reasons of clarity, these variables are not shown.

Descriptive statistics and relations between variables

Table 1 shows the means, standard deviations and Cronbach's alphas for all the variables for both groups. Table 2 shows the correlations between all variables for both groups.

The BDW was moderate in our participants. The unhygienic out-group origin was seen as most likely by participants in all waves, followed by the natural and conspiracy origins (all $ps < .001$). This in itself is striking: items relating to the official explanation of the disease were deemed less plausible than unhygienic out-group explanations. Aid intervention

DOI: 10.1002/casp



Note. Dashed lines represent negative association.

Figure 2. Structural equation model: revised hypothesized structural equation model for Wave 1 (top half) and Wave 2 (bottom half).

measures were seen as most effective, followed by expert-recommended measures, whereas discrimination-based protection measures were seen as least effective (all $ps < .001$).

The correlations between the two waves were high for both groups. Two correlations were smaller for the H5N1/H1N1 group than for the H5N1/H5N1 group: BDW ($z = 2.78$; $p = .005$) and unhygienic out-group origin ($z = 2.25$; $p = .024$). Overall, the correlation patterns were relatively similar for the two waves and groups. However, some differences in the strength of relations between variables in the two waves appeared (e.g. conspiracy origin was correlated negatively with expert protection in the H5N1/H1N1 group in Wave 2 but not in Wave 1). As we will test the structural equation model for the two waves simultaneously, we will test for potential significant differences in relations between the two waves.

Chains of reasoning—H5N1/H5N1 group

As the first test, we analysed the expected model for the H5N1/H5N1 group (people responding always to H5N1), by constraining all paths for which we did not have specific predictions to zero (Figure 2). Fit indices were satisfactory: $\chi^2(661) = 964.91$, $\chi^2/df = 1.46$, $CFI = 0.94$, $SRMR = 0.080$, $RMSEA = 0.040$ (0.034–0.045). The analysis yielded no major modification indices, indicating that our expected model contained no serious misspecifications. We did not include additional paths (even when correlations were significant, e.g. conspiracy origin to discrimination measures), as modification indices indicated that they would not significantly improve the model. To test whether the strength of the effects was similar between the two waves, we constrained all paths to be equal

DOI: 10.1002/casp

Table 2. Correlations between variables for the H5N1/H5N1 group in the first half of the table and for the H5N1/H1N1 group in the second half of the table

	BDW	Unhygienic out-group origin	Conspiracy origin	Natural origin	Discrimination	Aid	Expert
BDW	.82***	.25***	.23***	−.28***	.31***	−.05	.03
Unhygienic out-group origin	.31***	.44***	.05	−.08	.17**	.21***	.12*
Conspiracy origin	.36***	.05	.69***	−.18**	.22***	−.05	−.04
Natural origin	−.27***	−.05	−.25**	.45***	−.11	.07	.20***
Discrimination	.34***	.21***	.20***	−.17**	.56***	−.06	.27***
Aid	−.12*	.10	−.20***	.12*	−.06	.47***	.16**
Expert	.01	.14*	.03	.16**	.26***	.13*	.38***
BDW	.73***	.21***	.22***	−.16**	.32***	.00	.09
Unhygienic out-group origin	.18**	.28***	.07	−.16**	.20**	.04	.01
Conspiracy origin	.26***	.06	.63***	−.06	.14*	−.23***	.02
Natural origin	−.15**	.03	−.19**	.41***	.03	.00	.17**
Discrimination	.34***	.29***	.13*	−.01	.48***	−.05	.38***
Aid	−.02	.21***	−.23***	.04	.12*	.53***	.10
Expert	.03	.20**	−.17**	.18**	.29***	.28***	.41***

Note: Correlations between Wave 1 variables are on the upper right side of the diagonals. Correlations between Wave 2 variables are on the lower left side of the diagonals. Correlations between Waves 1 and 2 are on the diagonal.
BDW, belief in a dangerous world.
***$p < .001$.
**$p < .01$.
*$p < .05$.

DOI: 10.1002/casp

between the two waves. If the model fit of the constrained model is not significantly worse than the unconstrained model (as shown by a non-significant Chi-square difference test), the paths can be considered equal. With the exception of the path from conspiracy origin to aid intervention measures, all paths could be set as equal without decreasing model fit ($p = .397$). Model fit indices for this final model for the H5N1/H5N1 group were satisfactory: $\chi^2(671) = 975.42$, $\chi^2/df = 1.45$, $CFI = 0.94$, $SRMR = 0.081$, $RMSEA = 0.040$ (0.034–0.045). Table 3 shows the standardized path coefficients for the constrained model.

The analyses confirm that our expected model adequately fits the data. The origin explanations of H5N1 were strongly associated with BDW: the more people believed that the world is dangerous, the more they perceived the H5N1 origin to be due to a conspiracy or unhygienic out-groups, whereas the more they saw the world as safe, the more they endorsed a natural origin. These associations were significant in both waves. The first step of our model was therefore confirmed. The second step concerning the links between origins and protection measures was partially confirmed: as expected, the more people perceived H5N1 to be due to a natural origin, the more they thought expert-recommended protection measures were effective, whereas the more people endorsed an unhygienic out-group origin, the more they considered discrimination measures to be effective. Also, the more people saw a conspiracy origin as likely, the more they evaluated aid intervention measures to be ineffective, although this effect was only present in Wave 2. However, there was no relation between natural origin explanations and perceived effectiveness of aid intervention measures and no relation between conspiracy-origin explanations and perceived effectiveness of expert-recommended measures. Of the socio-demographic variables, only education had a consistent negative association with BDW in both waves, whereas neither gender nor age was associated with BDW.

In addition to these direct effects, there were several indirect effects (Preacher & Hayes, 2004): education had positive indirect effects on natural origin and expert-recommended protection measures and negative indirect effects on unhygienic out-group and conspiracy

Table 3. Constrained standardized path coefficients for the revised hypothesized model for the H5N1/H5N1 group and the H5N1/H1N1 group

	H5N1/H5N1 group		H5N1/H1N1 group	
	Wave 1	Wave 2	Wave 1	Wave 2
BDW ➔ unhygienic out-group origin	.47***	.48***	.35***	.33***
BDW ➔ conspiracy origin	.37***	.41***	.26***	.23***
BDW ➔ natural origin	−.30***	−.36***	−.16*	−.15*
Unhygienic out-group origin ➔ discrimination	.27***	.27***	.27***	.32***
Conspiracy origin ➔ aid	.01	−.22***	−.22***	−.26***
Conspiracy origin ➔ expert	.03	.03	−.08	−.10
Natural origin ➔ aid	.11	.09	.07	.08
Natural origin ➔ expert	.32***	.28***	.25***	.27***
Gender ➔ BDW	.04	.04	.05	.05
Age ➔ BDW	.05	.05	.17**	.17**
Education ➔ BDW	−.45***	−.43***	−.38***	−.37***

Note: BDW, belief in a dangerous world.
***$p < .001$.
**$p < .01$.
*$p < .05$.

DOI: 10.1002/casp

origins, and on discrimination measures in both waves (all ps $< .01$), whereas the positive effect on aid interventions was only significant in Wave 2 ($p < .01$). Additionally, BDW had indirect positive effects on discrimination measures and negative effects on expert-recommended measures in both waves and an indirect negative effect on aid intervention in Wave 2 (all ps $< .05$).

Replication of the chains of reasoning—H5N1/H1N1 group

We tested whether this model could be replicated with a different sample and different strain of influenza. As we described before, in this sample, participants were asked first about H5N1 and then—1 year later—about H1N1. We proceeded the same way as before (testing the hypothesized model for Waves 1 and 2 and then constraining paths between waves to be equal).

Model fit indices for the hypothesized unconstrained model were again satisfactory: $\chi^2(661) = 1105.62$, $\chi^2/df = 1.67$, $CFI = 0.91$, $SRMR = 0.084$, $RMSEA = 0.048$ (0.043–0.053). We compared this unconstrained model with the model in which all paths were set as equal between Waves 1 and 2, which did not decrease model fit ($p = .090$): $\chi^2(672) = 1123.29$, $\chi^2/df = 1.67$, $CFI = 0.91$, $SRMR = 0.086$, $RMSEA = 0.048$ (0.043–0.053).

The results linking BDW, origin explanations and protection measures were the same as for the H5N1/H5N1 group with the exception that conspiracy origin was negatively associated with aid intervention measures in both waves (instead of only Wave 2).

The effects of education were the same as before. We found indirect positive effects for age on unhygienic out-group and conspiracy origins, and discrimination measures, and indirect negative effects for age on natural origin and expert-recommended and aid intervention measures (all ps $< .05$). As before, BDW had indirect positive effects on discrimination measures and negative effects on expert-recommended (natural origin as mediator) and aid intervention measures in both waves (all ps $< .01$).

DISCUSSION

On the basis of SRT, our original hypothesis stated that laypersons follow two distinct chains of reasoning to explain H5N1 and H1N1 protection measures. Although the hypothesized model had to be revised when analysing the data, the final model appears to fit not only the data but also the theoretical framework we presented. Our findings support the expected association between origin explanations of influenza and perceived effectiveness of intervention measures, which depends on BDW: people explain and analyse information according to their position towards the dangerous nature of their environment.

Our data confirmed that the expert explanation inspired the reasoning of people who believe in a safe world, especially those who are highly educated. As expected, these people also perceived expert-recommended protection measures to be effective but, contrary to our hypothesis, did not see aid intervention measures as effective: the representation of the disease as a part of nature might have made it seem less threatening, thus leading respondents to deem aid intervention measures unnecessary.

However, we discovered that the attribution of origins to actions of humans includes two different chains of reasoning: The first is based on conspiracy theories where

DOI: 10.1002/casp

groups are seen as intentionally creating and spreading a disease, whereas the second one is based on xenophobia where the out-group is seen as being primitive or powerless, that is, as not having the means, knowledge or self-control to avoid disease (Joffe & Staerklé, 2007). This differentiation had an impact on the whole model by defining two distinct chains of reasoning both anchored in the BDW. First, blaming out-groups because of unhygienic habits was associated with stronger support for discrimination of unfamiliar others. Second, inferring evil actions of powerful groups induced greater rejection of aid measures. This revision of our initial model can be explained by previous research on disease threat. For instance, studies conducted on the impact of infectious disease threats have shown that people who feel more vulnerable (i.e. high in BDW) exhibit more negative attitudes towards unfamiliar foreign out-groups (e.g. Faulkner, Schaller, Park, & Duncan, 2004; Green et al., 2010). Adequate protection behaviour in this case seems to be discrimination of these groups, which is what we found in our study. On the other hand, disease threat can also lead to belief in conspiracy theories, which in turn are associated with non-adherence to official protection measures (e.g. Ross et al., 2006). In our study, conspiracy theories are linked with suspicions of alliances between powerful organizations and are associated with perceived ineffectiveness of aid interventions but unrelated to expert-recommended measures. These results show that individuals' protection measures are influenced by fundamental beliefs and origin explanations. Future narrative studies might focus more specifically on the different chains of reasoning to detail the anchoring process and the development of thinking towards expert protection measures. Experimental studies might, in turn, investigate how emotional reactions, such as fear of viruses, intervene in the relationship between BDW and origin explanation of an epidemic disease.

Table 2 indicated additional associations between origins and protection measures as, for instance, between conspiracy origin and discrimination measures. One might speculate that people believing in the conspiracy origin may be distrustful not only of the government but also of out-groups in general, which makes them believe discrimination measures to be effective. Additionally, discrimination and expert protection measures were positively associated indicating that people might consider avoiding foreigners as a special case of the avoidance measures recommended by experts. The association between the two protection measures was, however, not very strong, indicating that individuals do make a distinction between the two.

Association between origin explanations and protection measures in H5N1 and H1N1

By asking half of the respondents in Wave 2 about H5N1 and the other half about H1N1, we were able to test the structural model for both diseases. From an epidemiological perspective, these diseases are clearly different, not only because H1N1 had stronger epidemic impact but also because the H5N1 virus has very high mortality rates (60%, WHO, 2005) contrary to the H1N1 virus (0.03% in England, Donaldson et al., 2009). Moreover, the information and recommendations by Swiss health authorities towards the public were more frequent in the case of H1N1 than in H5N1, because of the official pandemic status of H1N1. One could therefore argue that people may be more inclined to follow expert reasoning in the former than in the latter case. Our results, however, show that the chains of reasoning are similar for both the H5N1/H5N1 and H5N1/H1N1 groups. This suggests that—as expected—BDW organizes chains of reasoning about origins and protection

DOI: 10.1002/casp

measures of diseases, which are not limited to H5N1, but shows similar patterns for different types of influenza. Moreover, the longitudinal design of the study also allowed us to confirm the stability of the different modes of reasoning our final model revealed. These results demonstrate that people are not simply ill-informed in ignoring some protection measures (Wynne, 1991) but that they follow a—consistent—line of reasoning, based on their previous explanations of the disease origin.

Chains of reasoning in making sense of emerging infectious diseases

Our analyses are based on an adult sample of French-speaking Swiss, with the same characteristics (e.g. age and education) as the general population of Switzerland, which suggests external validity of our findings. The chains of reasoning thus offer an innovative exploration of how laypersons incorporate both common sense and scientific explanations in their sense-making of infectious diseases. People might receive information about the transmission of the virus, but its ultimate origins often remain mysterious. Indeed, people may know that some corporations have evidenced unsavoury practices in the past (e.g. test of vaccines on minorities) and that there is a risk of contracting illnesses when visiting foreign countries. It may thus not be surprising that we observe different ways of treating and organizing this conflicting information. Our results show that this process—as SRT posits—is anchored in the broad and stable belief that the world is more or less dangerous. If the modern health system cannot offer sufficient protection, because of the continuous emergence of new viruses, people turn to their reference groups to see how to behave and what to believe. This well-known normative group dependency (e.g. Hogg, Turner, & Davidson, 1990) explains how chains of reasoning differ by level of education of participants: in our study, more educated participants were more trusting in the modern health care system than less-educated ones.

Limitations

Our final model differed from our hypothesized one. Consequently, the chains of reasoning underlying the revised model were partially defined by data and have to be taken as an explorative study in this domain. The most important problem of our study concerns the one-item measure of the unhygienic out-group explanation. However, the model we obtained is theoretically grounded and offers an extensive and systematic view of how people associate explanations of and protection from two different strains of influenza across time.

Our participants evaluated the effectiveness of different types of protection measures, but we do not know whether they actually engaged in them. Previous studies have, however, shown a consistent association between perceived effectiveness of protection measures and protection behaviours (e.g. Liao et al., 2010), suggesting that origin explanations influence not only perceived effectiveness of protection measures but also specific protection behaviour.

Finally, our study is correlational, which does not warrant causal claims regarding the chains of reasoning. It is important to note, however, that we do not expect the chains of reasoning to be strictly one-directional. Perceived effectiveness of protection measures may influence the assumed plausibility of different types of origins in other diseases, thus perpetuating and stabilizing the chains of reasoning.

CONCLUSION

This study highlights the importance of fundamental beliefs in organizing people's explanations about the origin of diseases and the associations between these explanations and the perceived effectiveness of protection measures. Sudden and threatening events such as disease outbreaks lead to discussions as laypersons try to make sense of the event (Gilles et al., 2013). However, although they may share common knowledge about the threat (e.g. expert-recommended measures), people may not hold the same fundamental beliefs to structure the information: prior beliefs are used as an organizing principle that links pieces of information in a chain of reasoning.

Our study contributes to the discussion of public health policies: we demonstrate that people's reactions towards official protection recommendations are associated with different points of view about the social world. Consequently, public health communication about diseases has to take into account laypersons' chains of reasoning when proposing protection measures. More specifically, it seems crucial to present information according to beliefs that organize everyday thinking towards the disease.

Moreover, the emergence of different kinds of infectious diseases in the last 10 years seems to have reinforced alternative points of view to the modern medical system in western societies. In particular, people seem to be searching for meaning in the apparent repetition of epidemics. Consequently, they reactivate traditional forms of explanations and protection, especially towards stigmatized or powerful groups. Prevention campaigns should therefore incorporate these chains of reasoning in their discourse instead of focusing only on the distinction between scientific effectiveness and common-sense irrationality. This means that protection measures should be presented in relation to the origin of the disease. Some campaigns have performed this. For example, campaigns for HIV prevention advocate condom use by explicitly linking the origin of the disease (sexually transmitted virus) with the protection measure (condom use). This also means that information should be diffused through trusted people or groups to favour a chain of reasoning that avoids conspiracy-origin explanations or the rejection of out-groups.

ACKNOWLEDGEMENTS

Research was funded by two grants (100014_122366 and 100014_132023) from the Swiss National Science Foundation awarded to Adrian Bangerter, Eva Green and Alain Clémence.

REFERENCES

Altemeyer, B. (1988). *Enemies of freedom: Understanding right-wing authoritarianism*. San Francisco: Jossey-Bass.

Bangerter, A., & Heath, C. (2004). The Mozart effect: Tracking the evolution of a scientific legend. *British Journal of Social Psychology*, *43*, 605–623.

Bauer, M. W. (1998). The medicalization of science news: From the 'rocket-scalpel' to the 'gene-meteorite' complex. *Social Science Information*, *37*, 731–751.

Bauer, M. W., & Gaskell, G. (1999). Towards a paradigm for research on social representations. *Journal for the Theory of Social Behavior*, *29*, 163–186.

Campion-Vincent, V. (1989). Complots et avertissements: Légendes urbaines dans la ville. [Conspiracies and warnings: Urban legends in the city]. *Revue Française de Sociologie*, *30*, 91–105.

DOI: 10.1002/casp

CDC. (2010). Interim results: State-specific influenza A (H1N1) 2009 monovalent vaccination coverage—United States, October 2009—January 2010. *Morbidity and Mortality Weekly Report*, *59*, 363–368.
Champion, V. L., & Skinner, C. S. (2008). The health belief model. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.) *Health behavior and health education: Theory, research, and practice* (pp. 45–66). San Francisco: Jossey-Bass.
Doise, W. (1993). *Logiques sociales dans le raisonnement*. [Social logic in reasoning]. Paris: Delachaux et Niestlé.
Doise, W., Clémence, A., & Lorenzi-Cioldi, F. (1993). *Quantitative analysis of social representations*. London: Harvester Wheatsheaf.
Donaldson, L. J., Rutter, P. D., Ellis, B. M., Greaves, F. E. C., Mytton, O. T., Pebody, R. G., & Yardley, I. E. (2009). Mortality from pandemic A/H1N1 2009 influenza in England: Public health surveillance study. *British Medical Journal*, *339*, b5213.
Duckitt, J., Wagner, C., du Plessis, I., & Birum, I. (2002). The psychological bases of ideology and prejudice: Testing a dual process model. *Journal of Personality and Social Psychology*, *83*, 75–93.
Echebarria Echabe, A., Guede, E. F., Sanjuan Guillen, C., & Valencia Garate, J. F. (1992). Social representations of drugs, causal judgment and social perception. *European Journal of Social Psychology*, *22*, 73–84.
Faulkner, J., Schaller, M., Park, J. H., & Duncan, L. A. (2004). Evolved disease-avoidance mechanisms and contemporary xenophobic attitudes. *Group Processes and Intergroup Relations*, *7*, 333–353.
Gilles, I., Bangerter, A., Clémence, A., Green, E. G. T., Krings, F., Mouton, A., … Wagner-Egger, P. (2013). Collective symbolic coping with disease threat and othering: A case study of avian influenza. *British Journal of Social Psychology*, *52*, 83–102.
Gilles, I., Bangerter, A., Clémence, A., Green, E. G. T., Krings, F., Staerklé, C., & Wagner-Egger, P. (2011). Trust in medical organizations predicts pandemic (H1N1) 2009 vaccination behavior and perceived efficacy of protection measures. *European Journal of Epidemiology*, *26*, 203–210.
Green, E. G. T., & Clémence, A. (2008). Discovery of the faithfulness gene: A model of transmission and transformation of scientific information. *British Journal of Social Psychology*, *47*, 497–517.
Green, E. G. T., Krings, F., Staerklé, C., Bangerter, A., Clémence, A., Wagner-Egger, P., & Bornand, T. (2010). Keeping the vermin out: Perceived disease threat and ideological orientations as predictors of exclusionary immigration attitudes. *Journal of Community and Applied Social Psychology*, *20*, 299–316.
Gul Cirhinlioglu, F., & Cirhinlioglu, Z. (2010). Social representations of H1N1 influenza A (Swine Flu). *Revija za sociologiju*, *40*, 273–295.
Hogg, M. A., Turner, J. C., & Davidson, B. (1990). Polarized norms and social frames of reference: A test of the self-categorization theory of group polarization. *Basic and Applied Social Psychology*, *11*, 77–100.
Joffe, H. (1999). *Risk and 'the other'*. Cambridge: Cambridge University Press.
Joffe, H., & Lee, N. Y. L. (2004). Social representation of a food risk: The Hong Kong avian bird flu epidemic. *Journal of Health Psychology*, *9*, 517–533.
Joffe, H., & Staerklé, C. (2007). The centrality of the self-control ethos in western aspersions regarding outgroups: A social representational approach to stereotype content. *Culture and Psychology*, *13*, 395–418.
Jones, J. H., & Salathé, M. (2009). Early assessment of anxiety and behavioral response to novel swine-origin influenza A (H1N1). *PLoS ONE*, *4*, e8032.
Kalichman, S. C., & Simbayi, L. (2004). Traditional beliefs about the cause of AIDS and AIDS-related stigma in South Africa. *AIDS Care*, *16*, 572–580.
Liao, Q., Cowling, B. J., Lam, W. W. T., & Fielding, R. (2010). The influence of social-cognitive factors on personal hygiene practices to protect against influenzas: Using modelling to compare avian A/H5N1 and 2009 pandemic A/H1N1 influenzas in Hong Kong. *International Journal of Behavioral Medicine*, *18*, 93–104.
Liao, Q. Y., Lam, W. W. T., Dang, V. T., Jiang, C. Q., Udomprasertgul, V., & Fielding, R. (2009). What causes H5N1 avian influenza? Lay perceptions of H5N1 aetiology in South East and East Asia. *Journal of Public Health*, *31*, 573–581.

Lorenzi-Cioldi, F., & Clémence, A. (2001). Group processes and the construction of social representations. In M.A. Hogg, & S. Tindale (Eds.), *Blackwell handbook of social psychology: Group processes* (pp. 311–333). Oxford: Blackwell.

Montano, D. E., & Kasprzyk, D. (2008). Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.) *Health behavior and health education: Theory, research, and practice* (pp. 67–122). San Francisco: Jossey-Bass.

Moscovici, S. (1961). *La psychanalyse, son image et son public*. [Psychoanalysis, its image, and its public]. Paris: Presses Universitaires de France.

Moscovici, S. (2000). *Social representations: Explorations in social psychology*. Oxford: Blackwell Publishers.

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods*, *36*, 717–731.

Radley, A., & Billig, M. (1996). Accounts of health and illness: Dilemmas and representations. *Sociology of Health and Illness*, *18*, 220–240.

Ross, M. W., Essien, E. J., & Torres, I. (2006). Conspiracy beliefs about the origin of HIV/AIDS in four racial/ethnic groups. *Journal of Acquired Immune Deficiency Syndromes*, *41*, 342–344.

Rubin, G. J., Amlot, R., Page, L., & Wessely, S. (2009). Public perceptions, anxiety, and behaviour change in relation to the swine flu outbreak: Cross sectional telephone survey. *British Medical Journal*, *339*, b2651.

Schaller, M., Park, J. H., & Faulkner, J. (2003). Prehistoric dangers and contemporary prejudices. *European Review of Social Psychology*, *14*, 105–137.

Setbon, M., & Raude, J. (2010). Factors in vaccination intention against the pandemic influenza A/H1N1. *European Journal of Public Health*, *20*, 490–494.

Swiss Federal Office of Public Health. (2010). Grippe H1N1: Strategie nach der pandemiewelle 2009 und ausblick auf 2010. [Strategy after the 2009 pandemic and perspective on 2010]. *Bulletin 10*, 332–335.

Wagner, W. (2007). Vernacular science knowledge: Its role in everyday life communication. *Public Understanding of Science*, *16*, 7–22.

Wagner, W., & Hayes, N. (2005). *Everyday discourse and common sense: The theory of social representations*. New York: Palgrave Macmillan

Wagner-Egger, P., & Bangerter, A. (2007). La vérité est ailleurs: Corrélats de l'adhésion aux théories du complot. [The truth lies elsewhere: Correlates of belief in conspiracy theories]. *Revue Internationale de Psychologie Sociale*, *20*, 31–61.

Washer, P. (2006). Representations of mad cow disease. *Social Science and Medicine*, *62*, 457–466.

Washer, P. (2010). *Emerging infectious diseases and society*. New York: Palgrave Macmillan.

Washer, P., & Joffe, H. (2006). The "hospital superbug": Social representations of MRSA. *Social Science and Medicine*, *63*, 2141–2152.

Whetten, K., Leserman, J., Whetten, R., Ostermann, J., Thielman, N., Swartz, M., & Stangl, D. (2006). Exploring lack of trust in care providers and the government as a barrier to health service use. *American Journal of Public Health*, *96*, 716–721.

WHO. (2005). The writing committee of the World Health Organization (WHO): Consultation on human influenza A/H5. Avian influenza A (H5N1) infection in humans. *New England Journal of Medicine*, *353*, 1374–1385.

WHO (2010). What can I do? Global Alert and Response Report. Retrieved on July 9th, 2012 from http://www.who.int/csr/disease/swineflu/frequently_asked_questions/what/en/index.html

WHO. (2012). Cumulative number of confirmed human cases for avian influenza A/(H5N1) reported to WHO, 2003–2013. Retrieved on April 8th, 2013 from http://www.who.int/influenza/human_animal_interface/EN_GIP_20130312CumulativeNumberH5N1cases.pdf

Wynne, B. (1991). Knowledges in context. *Science, Technology and Human Values*, *16*, 111–121.

DOI: 10.1002/casp