Spring 5-29-2015

Should I Get That Jab? Exploring Influence to Encourage Vaccination via Online Social Media

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ISBN 978-3-00-050284-2

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Research in Progress

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Abstract

This paper explores the suitability of online social media (OSM) as a means of influencing the public's decision-making process regarding vaccinations, specifically a vaccination to protect girls against HPV, a virus associated with cervical cancer. Using the Health Belief Model (HBM), we carry out an experimental study of the influence of cues to action, and of other's opinions, via OSM, on the parents' attitude towards the vaccine and on their intention to vaccinate. Analyses revealed no effect of our experimental manipulations of the different cues to action on their vaccination decision. However, using an exploratory novel network analysis, we find that the HBM does not adequately account for influence via OSM. Specifically we show that vaccination decisions are not taken in social isolation, a fact thus far ignored by various forms of the HBM. These tentative findings may guide alternative approaches for influencing the public's decision-making process. Implications for studies assessing the use of online channels for health communication are discussed.

Keywords: Social Network Sites, Healthcare, Social Influence, Network Analysis.

1 Introduction

The research described in this paper endeavours to explore the suitability of online social media (OSM) as a means of influencing the public's decision-making process regarding vaccinations. The overall prevalence of the human papillomavirus (HPV) that causes cervical cancer (Bosch, Lorincz, Munoz, Meijer, & Shah, 2002) was estimated 9.2% in Europe (Clifford, 2005) and 26.8% in the US (Dunne et al., 2007). This makes HPV one of top ranking sexual transmitted diseases, not only in Western countries but around the world. For this reason, in many Western countries young girls are currently being vaccinated to protect them from the effects of this virus. However, societal penetration of this inoculation is much lower than other vaccinations, which has caused substantial concern and debate. For example, in the Netherlands most vaccination programs achieve a penetration of more than 90% but the HPV-vaccination remained at around 50% in its first year, 2009 (van Keulen et al., 2013), and has still not reached 60%.

Peoples' understanding of health-related issues, and their health-related choices are increasingly influenced by information distributed via the internet and OSM (Fox, 2008; Betsch and Sachse, 2012; Grajales et al., 2014). OSM have proven to be highly effective at influencing public opinion by promoting a critical position with respect to the government's vaccination policy (Campbell &

Salathé, 2012). Consequently, anti-vaccination reporting – for example, via the internet and OSM, by worried parents, the alternative medical community and others – has become an important factor explaining the low level of public acceptance of vaccinations (Kata, 2012; Nan and Madden, 2012; Nicholson and Leask, 2012; Zimmerman, et al., 2005).

The Information Systems community is ideally suited to offer new insights about the role of the social internet on vaccination decisions. We define online social media (OSM) as having unique user profiles, user-generated digital content, and relational connections. OSM include online blogs and microblogs, social network applications, and online forums (Kaplan and Haenlein, 2010). In many countries, OSM have quickly become a dominant arena for consumers and citizens to express their views openly and learn from others' views. Social influence thus becomes an important mechanism in OSM (Stieglitz and Dang-Xuan, 2013; Langley et al., 2014; Matook, Brown, and Rolf, 2015). OSM have been shown to play a role in influencing health-related opinions and behaviors (Fichman, Kohli, and Krishnan, 2011; Yan and Tan, 2014), and they have indeed been implicated in the low uptake of the HPV vaccination (Kata, 2012). What has not yet been shown is evidence that the same OSM are also suitable for promoting the scientific or government's position and thereby balancing the debate in controversial issues (Keelan et al., 2010).

In this paper, we attempt to develop knowledge about whether and which interventions can be used online to actively support offline vaccination behavior, once negative information has been spread via OSM. Specifically, in this paper we explore the suitability of OSM as a means of intervening in the public's decision making process. We do this by analyzing the effect of different cues to action communicated via online discussion forums on the behavioral intention to receive the vaccination against HPV. To this end, we invited parents of daughters due to be called up to receive their vaccination, to participate in an online discussion forum where they could discuss their stand on their daughter's getting or not getting a vaccination to protect them against HPV. We presented cues to action on the forums, in direct response to an anti-vaccination opinion, such that they promoted vaccination in different ways. After their active participation on the forums, we measured the participants' attitude towards the vaccination.

In the following sections we describe our model development, the method using an online discussion forum, data collection, results and we conclude with a discussion of the initial findings and their relevance for health communication via OSM.

2 Model development

Health decisions, such as a decision to get vaccinated, are assumed to depend on a complexity of cognitions and attitudes. The Health Belief Model (HBM; Rosenstock, 1966; Janz and Becker, 1984) specifies the most elemental of these cognitions and attitudes and was constructed to explain which beliefs should be targeted in communication campaigns to cause positive health behaviors. Four constructs are proposed to vary across individuals and to be predictive of adopting health-related behaviors, including receiving vaccinations. First, individuals should believe they are susceptible to a particular negative health outcome. Second, individuals should believe that this negative health outcome is severe or threatening. Third, the proposed solution should be effective and prevent the negative health outcome. Fourth, is the role of a cue to action. This cue is necessary for prompting engagement in health-promoting behaviors. Cues to action include internal cues, such as pain or discomfort, or external cues, such as media campaigns, or conversations with others. The intensity of cues needed to prompt action is moderated by an individual's perceived susceptibility, seriousness, benefits, and barriers (Rosenstock, 1974). Since Rosenstock put forward his original version of the HBM, it has been noted that the cue to action is the most underdeveloped and least researched element of the HBM (Carpenter, 2010). This paper tries to fill this void. Additionally, we posit that health choices are not taken in social isolation. As with many important decisions, others may play a role in the decision making process. One of the key mechanisms at work on OSM is the strong influence on individuals that can be exerted via peer connections (Watts and Dodds, 2007; Stieglitz and Dang-Xuan, 2013).

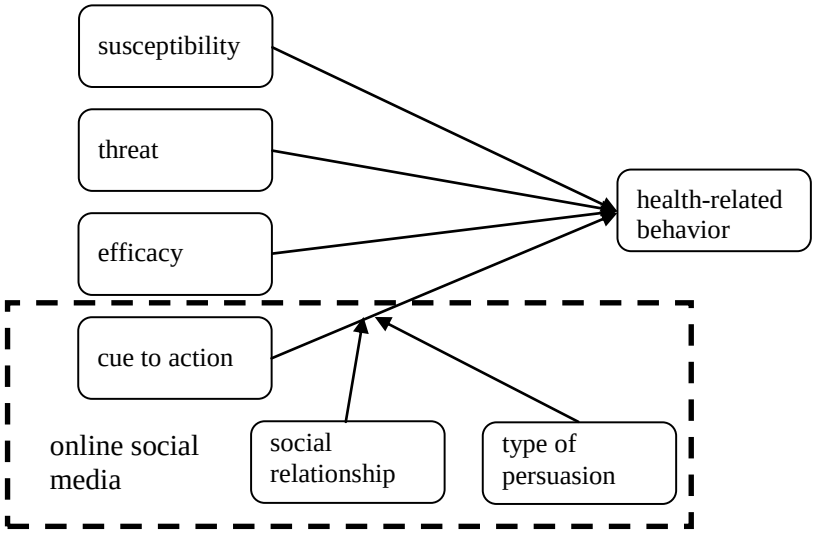

Figure 1. The Health Belief Model (Rosenstock, 1966) adapted to include influence effects via Online Social Media (OSM)

That is, individuals with close interpersonal bonds tend to influence each other (Sassenberg & Boos, 2003; Pornpitakpan, 2004; Cialdini & Petty, 2001). In the case of health decisions, however, peers are often not health experts. Also, the formal authority enjoyed by health professionals, or governmental health officials could have a different influence than the interpersonal trust between people who interact in an online community (Anagnostopoulos, Brova, and Terzi, 2011). This leads to the question whether individuals will be persuaded to a greater extent in their health decisions by their peers than by health professionals, or governmental health officials, if at all. A second mechanism which has received attention in the psychology and communication literature is the role of different types of persuasive message in changing individuals' behavior. A distinction is made with respect to approach and avoidance tendencies toward some behavior and persuasive strategies that fit those tendencies (Knowles and Linn, 2004). Alpha strategies to promote a vaccination focus on "approach" by promoting gains, or putting forth reasons why someone should do something. In contrast, omega strategies focus on reducing resistance or "avoidance" by side-stepping or by directly or indirectly addressing resistance that can hold someone back from performing some behavior. Thus, for instance, when persuading an individual to get inoculated one could name all the reasons for doing it (e.g., reducing chances of illness, reducing chances to infect others, etc.), add incentives, or increase the credibility of the source of a persuasive message. These are alpha strategies. On the other hand, one could also focus on devaluing the reasons against getting the jab (e.g., it does not hurt so much, it does not make you ill, etc.). This is an omega strategy.

Thus far, in the case of the HPV inoculation efforts that the Dutch government has undertaken, it seems that most focus has been on alpha strategies. That is, inoculation advocates have persistently framed their message using positive persuasion (e.g., "The jab helps to prevent HPV"), and they have boosted their credibility (e.g., "you can trust us, we are scientists"). However, to date no efforts seem to have focused on omega strategies. We expect that this mechanism – the nature of the persuasive message, either alpha or omega – will also moderate the effect of cues to action on the intention to vaccinate. The model is shown in Figure 1.

3 Method

3.1 Participants and Design

A total of 184 participants (67% women; age: M = 43.07, SD = 5.37), recruited via a leading marketing research firm, took part in our experiment in exchange for special credits redeemable for products by the recruitment organization. All participants were parents of daughters born in 2001, 2002 or 2003 who would be invited by the responsible government health agency to get their HPV inoculation in the next cohorts. Participants were randomly assigned to the conditions of a 2 (source: peer vs. governmental organization) x 4 (influence strategy: source credibility, self-belief, direct challenge, indirect challenge) between-subjects design. The first two influence strategies are alpha strategies, approaching the vaccination issue in a positive way, and the latter two are omega strategies, devaluing the reasons against getting the vaccination. In our design, the parents took part in discussion forums where they were exposed to the conditions, and they subsequently filled in questionnaires where we measured the effects of the conditions on the dependent variables, vaccination attitudes and intention, as well as other relevant questions.

3.2 Procedure and data collection

Participants were invited by the recruitment organization to participate in an online discussion group to discuss raising adolescents and related issues. We informed participants that we were interested to know how parents discuss issues on OSM and how they value communicating about parenting issues with peer-parents. We asked them to log in on a specified date and time and to be available to participate in the experiment for fifty minutes. Besides the topic of interest to our study, we added two irrelevant topics of discussion so that the participants would not be aware what the experiment was about. This was to reduce bias on their responses to the HPV vaccination. Each participant was made to believe that the focus was on raising adolescents and related issues, and that parents would be asked to complete questionnaires on one of three topics, energy drinks, HPV vaccination and cyber bullying.

At first log in, participants first read and agreed with the informed consent information. We emphasized that all communications were anonymous and would only be used for scientific analysis and that their reactions would not be individually retraceable. Participants read that they would take part in an internet discussion forum, about topics of interest to parents of growing children who will soon be going to high school. They were told there were three topics for discussion, each lasting between one and fifteen minutes after which they would answer questions pertaining to one of the topics.

After clicking on the link to the forum, the participants saw the first topic on energy drinks, and could join the discussion. We used this first topic for people to get acquainted to the internet forum and to each other. The second topic introduced the HPV issue. The discussion was started by the host, as follows: "The government health service offers all girls in the Netherlands the opportunity to be vaccinated against the HPV virus, which can cause cervical cancer. Some people are for and some against this vaccination. What will you do? Share your opinion below and click on 'add message'".[1]

The first reaction, posted by a confederate, reflected often used criticism by anti-vaccination lobbyists (Kata, 2012), stressing strong side effects and the lobbying by pharmaceutical firms. Following this the next post in the timeline was from another confederate and communicated a pro-vaccination opinion. Depending on the condition the participant was assigned to this post was either from a peer (i.e., starting with the introduction: "I am the parent of two daughters") or a government official (i.e., starting with the introduction: "I am a spokesperson for the government health service") and was followed by a pro-vaccination comment along the lines of one of four persuasion strategies: persuasion by indirect challenge, persuasion by direct challenge, persuasion by self-belief, and persuasion by source

[1] Literal texts have been translated from Dutch for this paper.

credibility. For this topic, we manipulated the forum so that parents could not read each other's messages so that the only influence would be from the confederates. Once the participant had posted their opinion, we asked them to go on to the third topic, cyber bullying.

After all three discussions, the participants filled out a questionnaire, taken from van Keulen, et al. (2013). This questionnaire contained our dependent variables on attitudes and planned behavior regarding the HPV inoculation for their daughters and other questions relating to the HBM (Rosenstock, 1966). Specifically, we asked one question pertaining to the intention of getting the vaccination (i.e., Do you intend to have your daughter vaccinated against HPV?), four questions measuring valence of the vaccination (e.g., I find vaccinating my daughter very positive/negative; $\alpha = .98$), one question measuring how they viewed their daughter's chances of getting cervical cancer (i.e., I feel that the chance of my daughter getting cervical cancer later in life is very small/big"), one question measuring anticipatory regret of getting cervical cancer when not vaccinated, one question measuring anticipatory regret of suffering side effects after vaccination, four items measuring participants' trust in institutions (viz., science, healthcare, government, pharmaceutical industry; $\alpha = .91$), one item measured trust in other parents and one item measured trust in vaccination critics in relation to HPV, seven items measuring belief in counterarguments of vaccination critics (e.g., too little is known about side effect to vaccinate all young girls in The Netherlands; $\alpha = .83$), two questions measuring assumed positive effects of the HPV vaccination (e.g., when my daughter will receive the vaccination I think she will not get cervical cancer; $\alpha = .80$), five questions measuring assumed negative effects of the HPV vaccination (e.g., when my daughter will receive the vaccination I think she will become infertile; $\alpha = .61$). Finally, we asked what they thought their partner's, daughter's, parents', close friends', doctor's, health institutions', government's and other parents' opinions regarding the vaccination were. We also asked to what extent they valued these individuals' or institutions' opinions. For each set of these two questions – the other's opinion and the value attached to this opinion – we calculated the product to come to a measure of influence of this other individual or institution. All items were measured on Likert-type 5-point scales.

All participants were debriefed after filling in the questionnaire, whereby they received clear information about the experimental design, the scientific evidence for the efficacy of the vaccination and for its safety. This information was taken from the relevant government agency's promotional material regarding the HPV vaccination. All answered supplementary questions showing that they understood that the anti-vaccination message was fake, that no serious side effects are known and that the government's scientifically based policy is that all girls receive the vaccination[2].

3.3 Analysis

We analyzed our data in two ways. First, we tested our hypotheses regarding the effect of a cue to action (viz., the source of communication and persuasion strategies) on attitudes and the intention to get the vaccination using multivariate analyses of variance (MANOVA). Second, we employed a new network modelling method (Epskamp et al., 2012) to explore the relations between the variables measured. Specifically, this method was used to explore whether other variables than those already described in the HBM contribute to the decision making process regarding HPV vaccinations.

A 2 x 2 multivariate analysis of variance (MANOVA) did not yield statistically significant main effects of communication source (peer vs. organization) or persuasion strategy (alpha vs. omega), or an interaction effect of these factors on the perceived valence of HPV vaccinations and the intention to get the vaccination, all Fs < 2.15, ps > .19. The absence of significant effects means we are unable to reject the null hypothesis that a cue to action does not influence the decision making process. There are several explanations for this lack of effect. First, our manipulation may not have been strong enough. They consisted of only a few lines of text and tried to offer a nuanced perspective. Related to this, possibly the specific medium used (i.e., an online forum) does not lend itself well for nuanced

[2] The research ethics committee of the Netherlands Organisation for Applied Scientific Research was consulted during the design of this study.

positions. Often the focus of individuals is on finding and scrutinizing information that confirms ones original beliefs and sharing these beliefs back with the online community. A simple, nuanced message may have been too subtle to resort any effect. In any case, from the current findings no conclusions on the effect of our cue to action can be drawn.

Our second goal of the present research was to explore the relations between the variables measured, and to investigate relations beyond those already described in Health Belief Models. To estimate the network structure, we fitted a sparse Gaussian Graphical Model (GGM; Lauritzen, 1996) following Costantini et al. (2015) as is done in recent psychological literature (e.g., Fried et al. in press and McNally et al., 2014). In a GGM, variables are indicated by nodes that are connected by an edge if two variables are not independent after partialling out shared variance with all other variables in the dataset (Epskamp, Maris, Waldorp, and Borsboom, in press). The edges are parametrized as partial correlation coefficients; a partial correlation coefficient of zero indicates that two nodes are independent after conditioning on all other variables and thus feature no edge in the network.

To relax the assumption of multivariate normality, we employed the nonparanormal transformation (Liu, Lafferty and Wasserman, 2009) using the huge package (Zhao, Liu, Roeder, Lafferty and Wasserman, 2014). Subsequently, to control for spurious connections due to sampling error, we employed the least absolute shrinkage and selection operator (LASSO; Tibshirani, 1996) regularization technique as suggested by Costantini et al. (2015). We used the graphical LASSO (Friedman, Hastie and Tibshirani, 2008; Witten, Friedman, and Simon, 2011), which is a fast variant of the LASSO aimed at estimating the GGM. The graphical LASSO uses a shrinkage parameter to reduce the overall strength of parameter estimates and setting many parameter values to be exactly equal to zero, thus simplifying the model. We set this shrinkage parameter to minimize the extended Bayesian Information Criterion (EBIC; Chen, and Chen, 2008), which has been established to accurately recover the network structure (van Borkulo et al., 2014). GGM estimation, using the graphical LASSO in combination with EBIC, has been implemented in version 1.3.1 of the qgraph package for R (Epskamp et al., 2012; Epskamp et al., 2015).

The network was drawn using qgraph (Epskamp et al., 2012; Epskamp et al., 2015) version 1.3.1, in which edges are colored according to the strength of the partial correlations; positive partial correlations are displayed as green edges, negative partial correlations as red edges and the stronger the absolute value of the partial correlation the wider and more saturated the edge. For each node, the partial correlations between that node and all other nodes are directly related to the multiple regression coefficients of one variable when regressed on all other variables in the dataset (Pourahmadi, 2011). As such, the strength of partial correlations---the width and saturation of the edge---can be interpreted as predictive quality between two nodes. If node A is strongly connected with node B then node A predicts node B well and vice versa. A path in the network, such as node A is connected to node B and node B is connected to node C, can be interpreted as a mediation effect of node B on the predictive quality between node A and C.

4 Results

Results of the network analysis are shown in Figure 2, and offer new insights into the potential for OSM to be used as a channel for influencing health-related behavior. In particular, we highlight four specific findings from this explorative study: the nature of social influence, (a) from family, and (b) from peers, (c) the effects of the different influence strategies as online cues to action, and (d) the relevance of the HBM for the OSM setting.

First, we can see the influence of close family members by assessing the position of the participants' daughter and partner. Clustered with the intention to vaccinate are valence (the vaccination is a good/bad thing), and belief in the effectiveness of the vaccination. The variables "influence of the daughter" and "influence of the partner" are most strongly connected to this cluster of intention to vaccinate, valence and belief in the effectiveness of the vaccination. This reflects the strong direct relationships – partial correlations – between opinions within the nuclear family, and shows that the family plays a more important role than others, such as friends, in vaccination decision making. The

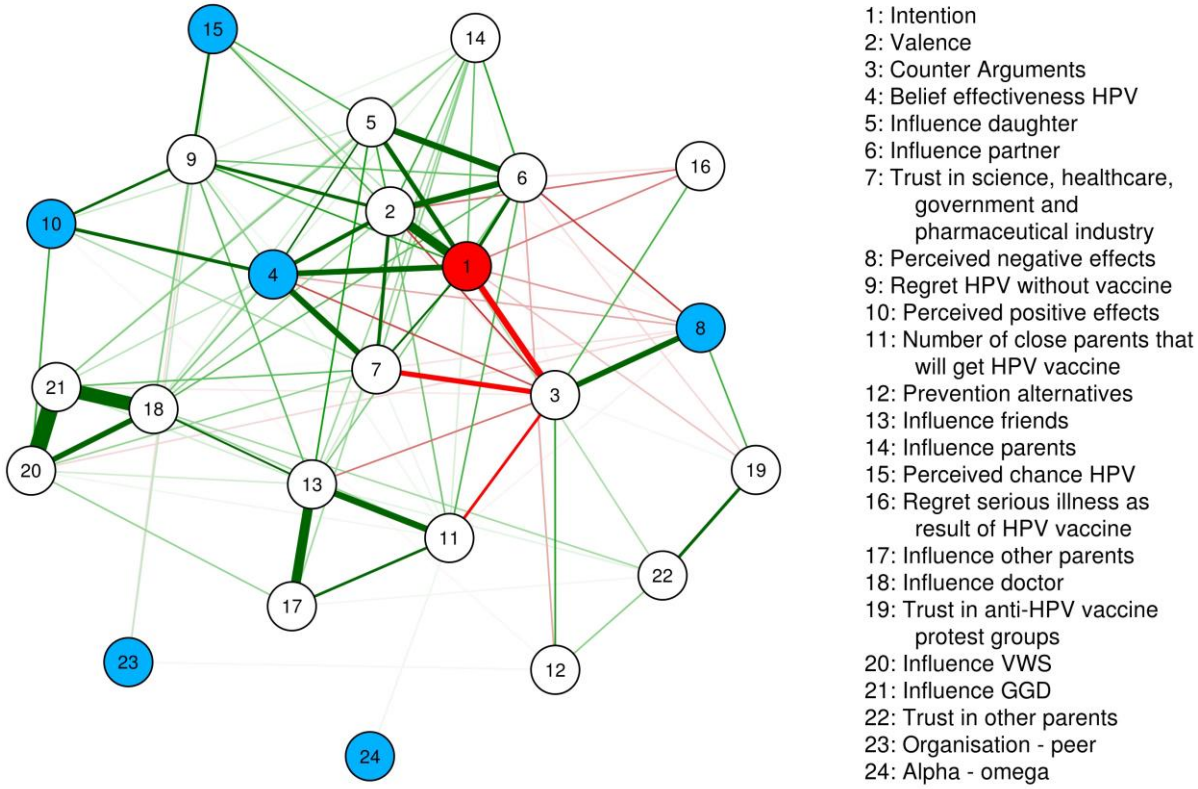

Figure 2. Network Analysis (qgraph) output for the adapted Health Belief Model (HBM), showing partial correlations between constructs. Traditional HBM constructs are shown in blue.

participants' parents also have a significant, albeit weaker, influence. Interestingly, our results highlight a difference between the influences between the participant and their daughter or partner. The daughter's opinion is predominantly related to the participant's intention to vaccinate, and less so to their valence with respect to the vaccination. The partner's influence is the other way around: predominantly related to the valence, and less so directly to intention. This means that partners are more likely to agree with each other about the vaccination being a good or bad thing, but that the opinion of the daughter who is to be vaccinated about whether to get the jab has most influence on that decision.

Second, we see that the influence of non-family is less related to the participants' intention or valence, including that of their friends, other (offline) parents they know, and online peers that they may not know. Even though the other parents joining in on the internet forum remained anonymous, their influence is highly similar to that of friends and offline peers, whom the respondents know well. This provides evidence for the immediate, and natural, relationships, and group feelings, that people develop via OSM. However, in our setting, the online peers do not play the moderating role that other authors have described (Park and Lee, 2009). Our manipulation of peer vs government spokesperson shows no direct relationship to the participants' intention or valence with respect to the vaccination.

Third, the influence of the different cues to action (27 and 28 in Figure 2) is negligible.

Fourth, our analysis reveals insights into the applicability of the HBM in relation to vaccination decisions, in the OSM setting. By looking at the position of the HBM elements in Figure 2(colored), we see mixed findings. The efficacy construct – node 4 in Figure 2 – is particularly strong in driving intention and valence with respect to the vaccination, but the other HBM constructs do not have such an effect in our study.

5 Discussion

When people make vaccination-related choices, they are influenced by various factors as described by the HBM, including their perceived susceptibility to the virus, the threat the virus poses to their health, their perception of the efficacy of the vaccination, and also the cues to action which they receive (Rosenstock, 1966). Increasingly, the internet and OSM are subjecting individuals to many conflicting opinions, confounding official government messages with opinions from anti-vaccination groups, the alternative medical community and others (Kata, 2012). As a result, decision-making becomes more complex. This explorative study attempts to offer new insights, using the Health Belief Model as a lens, about the role of OSM on vaccination decisions, and in particular about whether OSM also offer a suitable mechanism for promoting the government's position on a vaccination program, and thereby reducing the effect of the critics of vaccinations. These critics are particularly successful in reducing the public acceptance of the HPV vaccination, aimed at reducing the occurrence of cervical cancer. As such, we explore the suitability of online social media (OSM) as a means of influencing the public's decision-making process regarding HPV vaccinations.

In total, 184 parents of girls soon to be called up to receive the HPV vaccination took part in OSM discussion forums and communicated their opinions on three topics relating to their children, including the vaccination. In a carefully designed protocol, they were subjected to eight different conditions (between subjects) attempting to stimulate them to get their daughters vaccinated. Using a network modelling technique (Epskamp et al., 2012) we explored the influences on the participants' intentions to vaccinate, focusing on elements of the HBM. We find that opinions relating to the vaccination within the nuclear family have the strongest relationships, suggesting that influences via OSM may need to concentrate not just on one decision-maker, but on the interdependent family members. We find a strong direct link from the daughter's opinion to the focal parent's intention to vaccinate which may reflect the low power-distance culture in the Netherlands (c.f. Hofstede, 1991). The parent's opinion about the vaccination (valence) is less strongly related to that of the daughter, but whether they agree or not, the daughter's opinion is highly influential on the decision whether or not to vaccinate. The partner's opinion, on the other hand, predominantly influences the participant's own opinion (valence). In contrast, parents' friends and peers have a far weaker effect on the decision to vaccinate, whereby there appears to be almost no difference in influence between a person's close friends, the other parents they know in their social environment, and people they interact with via OSM. This suggests an important role for OSM in carrying mechanisms of influence, although in our study all these peer effects are minimal.

A key question in this study is if the HBM applies in the online setting. Our exploratory findings suggest that the elements of the HBM work differently via OSM, whereby perceived efficacy is highly influential and cues to action appear to have little influence. We also see that trust in authority remains influential, despite the claims for bottom-up empowerment which some authors make in relation to OSM.

We see three main avenues for continuing this study. First, in the current paper we have only analyzed the data from the questionnaire which was administered directly after the participants had taken part in the discussion forums. We may enrich our findings by also carrying out a content analysis of the comments made during the forum discussions. Second, health-related decisions can be complex and require a great deal of thought, and this is certainly the case for new vaccinations of children. In this study, we investigate the possibilities of using OSM as a means to 'nudge' parents to become more positive towards the HPV vaccination, in a single session on an OSM. Further research may uncover stronger influence effects if they assess the effect of a series of nudges, as these can be expected to build up to a stronger effect on attitudes and behaviors (Johnson et al., 2012). Finally, based on the influence approaches posited by Knowles and Linn (2004), and on competing theories of influence from peers versus authority figures (Watts and Dodds, 2007; Anagnostopoulos, Brova, and Terzi, 2011), we investigated influence via eight specific conditions. Although preliminary results do not show strong effects from these conditions, further research may include other online influence attempts by health professionals to uncover more successful influence effects.

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