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The Influence of Vaccine-Critical Websites on Perception of Vaccination Risks

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Abstract

This large-scale Internet-experiment tests whether vaccine-critical pages raise perceptions of the riskiness of vaccinations and alter vaccination intentions. We manipulated the information environment (vaccine-critical website, control, both) and the focus of search (on vaccination risks, omission risks, no focus). Our analyses reveal that accessing vaccine-critical websites for five to ten minutes increases the perception of risk of vaccinating and decreases the perception of risk of omitting vaccinations as well as the intentions to vaccinate. In line with the 'risk-as-feelings' approach, the affect elicited by the vaccine-critical websites was positively related to changes in risk perception.

Keywords: immunization, health decision making, individual differences, intuition, affect

The Influence of Vaccine-Critical Websites on Perception of Vaccination Risks

Der Glaube ist nicht der Anfang, sondern das Ende allen Wissens.

(Belief is not the beginning but the end of all knowledge)

JW Goethe (1749-1832)

Vaccinations in early childhood can prevent children from contracting serious illnesses. Even though one would expect parents to take advantage of the opportunity to immunize their children, the World Health Organization reports suboptimal vaccination coverage (such as for measles in Europe; Muscat et al., 2009). Hesitations regarding vaccination decisions are attributed to parental concerns about vaccination safety as well as a heightened perception of the risks associated with vaccinations (Benin et al., 2006; Chen, 1999).

Vaccine criticism and the Internet

Consulting certain sources of information seems to play a crucial role in this development (Benin et al., 2006; Freed, Clark, Hibbs & Santoli, 2004). Especially new and easily accessible media such as the Internet disseminate harsh criticism against vaccinations (Zimmerman et al., 2005). Nearly half of the websites on vaccination contain vaccine-critical information (Davies, Chapman, & Leask, 2002). Besides specific anti-vaccination content (such as linking vaccinations to specific chronic diseases), vaccine-critical websites also apply a specific style of communication: emotive appeals are presented in a vivid fashion, e.g. with photographs and pictures. Moreover, personal stories (case-based, individuating information) of children who were allegedly injured by vaccines were found on every second vaccine-critical website (Wolfe et al., 2002). The internet is therefore assumed to be increasingly influential in the decision not to immunize (e.g. Zimmerman et al., 2005).

The goal of this contribution is to make a first step in assessing *if* and *how* Internet vaccine-criticism might influence risk perceptions and vaccination intentions. We therefore compared perceptions of risk and intentions to vaccinate of Internet users who accessed an existing, typically vaccine-critical website or a control site. Further, possible mechanisms of this influence were explored.

Risk Perception and Preventive Health Behavior

The perception of risk is related to the omission and commission of vaccinations (e.g. Benin et al., 2006; Brewer et al., 2007; Freed et al., 2004) and represents a general predictor of preventive health behavior (Weinstein, 1993, van der Pligt, 1996). Even though some theories of protective health behavior include costs in the model, they usually refer to non-health costs (such as money, time, and effort; Weinstein, 1993); “beliefs about the risk *given* the preventive action are seldom reported” (Brewer et al., 2007, p. 137; italics added). Vaccinations are a special case of preventive health behavior as they involve the administration of pharmaceutical substances to a healthy organism. The substance may have, as do all medical treatments, undesired side effects. As the Internet is increasingly important in delivering health-related information and, at the same time, provides large amounts of (emotional, threatening) information about alleged adverse vaccination effects, it is necessary to pay more attention to the perception and effects of the risk of adverse side effects. While there is a positive relation between risk and preventive behaviour for the perception of the risks of vaccine-preventable illnesses, we expect a negative relation between the risk of adverse side effects and behaviour or intentions (Weinstein & Nicolich, 1993).

The content of vaccine critical websites on the Internet highlights the potential harm that vaccination might cause to the health of the individual. As such they make reasons salient that are in favor of omitting vaccinations and in disfavor of receiving vaccinations. The perception of risks is assumed to reflect the information that is salient or accessible at the

time of judgment (e.g. Ajzen & Fishbein, 1980). Accordingly, we expect that viewing vaccine-critical websites on the Internet will increase the perceived risk of vaccinations in the individual and decrease the perception of the risk of omitting vaccinations (as compared to a-priori perceptions of risk and to viewing a control site; Hypothesis 1a).

Models of protective health behavior assume that perceived risks are predictors of behavioral intention (Weinstein, 1993). Accordingly, we expect that viewing vaccine-critical websites will decrease vaccination intentions (as compared to a-priori intentions and to viewing a control site; Hypothesis 1b).

During online-research information is selected when the internal representation of the problem sufficiently resembles the information (Pirolli, 2005; Fu & Pirolli, 2007). This implies that links matching a search hypothesis are selected more frequently than links that are contrary or unrelated to a preconception. Additionally, focusing on one hypothesis could lead to an overweighting of supportive information (confirmation bias, Nickerson, 1998). Thus, applying a specific search focus (e.g. that vaccinating is risky) might increase encoding efforts for confirming information and decrease encoding efforts for disconfirming information (Klayman & Ha, 1987). Thus, we expected that a search focus placed on the risks of vaccination should increase the perceived risk to vaccinate and lower vaccination intentions. A search focus placed on the risk of omitting vaccinations, on the other hand, should increase the perceived risk of not-vaccinating and increase intentions to vaccinate (Hypothesis 2).

As stated above, vaccine-critical websites utilize a specific communication method: they provide individual, case-based information with emotive appeals. Research on the effect of individuating information as well as on the effect of affect and emotions on risk judgments will serve as the basis for exploring underlying mechanisms.

Possible Mechanisms

Case-based information substantially influences judgments and decisions (e.g. Hendrickx, Vlek & Oppewal, 1989; Ubel, Jepson & Baron, 2001). The *vividness* of the case-based information is often proposed to be responsible for the strong influence. Vividness, however, represents a rather broad and vague concept (Taylor & Thompson, 1982) that comprises a mixture of factors differing largely with regard to their impact. Of all factors belonging to the vividness concept, we expect that *affect* plays an important role in influencing risk judgments, as recent risk theories posit that affect elicited in the decision maker directly guides judgments of risk: The affect heuristic (Slovic & Peters, 2006) predicts that affect associated with a decision object can directly influence one's decision for, or against, the object. Information about benefits influences the degree of positive or negative affect, which in turn affects risk perception. A treatment (e.g. vaccination) that is said to have low benefits should elicit negative affect and be evaluated as more risky. The risk-as-feelings approach (Loewenstein, Weber, Hsee & Welch, 2001) assumes that risk perception is not only influenced by cognitions, but also by immediate global affective reactions (unspecified feelings of goodness/badness) and specific feelings (such as dread, threat) and emotions (e.g. fear).

In order to test our hypotheses, we compared risk judgments and vaccination intentions before and after Internet users searched different websites with different information search foci. Several post-hoc evaluations of the websites allowed for exploring the mechanisms in question.

Method

Participants and Design

Participants were recruited by publishing the link to the online-experiment on websites that distribute information either to parents or individuals interested in medical information or

science¹. 1912 Internet users opened the first page of the study. 1163 proceeded to the second page and 517 reached the end. The design comprises the factors *information environment* (vaccine-critical website, control site, both sites) and *focus of search* (instruction to test the assumption that vaccinating is risky, not vaccinating is risky, no specified focus). All dependent variables were measured repeatedly before and after viewing the websites.

Materials and Procedure

Information sources. As vaccine-critical website we selected <http://www.impfschaden.info> from a plethora of similar websites. When entering the German term “impfen” (vaccinate) in the most prominent German search engine (<http://www.google.de>), the website occurred within the first three results at the time of our online-survey and thus represents a frequently accessed source of vaccine-criticism. It aims at presenting an alternative view on immunization. In pretests we ensured that the selected website provides a typical exemplar of a vaccine-critical website (C. Betsch, 2009). The control site was <http://www.kindergesundheit-info.de/schutzimpfungen.0.html>. This website is hosted by the Federal Centre for Health Education (Bundeszentrale für gesundheitliche Aufklärung, BZgA), a specialist authority within the portfolio of the Federal Ministry of Health of the German government. It aims at taking a neutral stance concerning matters of interest.

Online-Experiment. The program (programmed with Globalpark, 2008) was identical for all participants with the exception of one randomly selected page, which contained the instruction for the respective manipulations. Participants were informed of the aim of the experiment and its approximate duration (ca. 30 minutes) and requested to close or switch off all communication devices (chat, ICQ, mobile, etc.). After providing their informed consent, participants gave some demographic information and answered questions concerning their

preferences for medical treatments, Internet habits regarding medical information search and their experience with the topic of immunization.

Following this, the pre-measures of the dependent variables were taken. Risk perceptions were assessed by degree of agreement with the statements: *Vaccinating causes considerable risks* and *Not-vaccinating causes considerable risks*.² (1) expressed disagreement, while (7) expressed full agreement. Then, vaccine-preventable illnesses and the respective vaccinations were mentioned. Participants then indicated the strength of their intentions to immunize their infant if they had the possibility to do so during the next week. The intentions were assessed regarding four different vaccinations:³ (1) expressed that they would definitely not vaccinate their infant, while (7) expressed that they would definitely vaccinate. Further, the fear of several different vaccine-preventable illnesses and frequently mentioned alleged side-effects was assessed.

Then, we manipulated the information environment for the subsequent information search. Participants were informed that they were randomly assigned to a specific website. The link opened a new window presenting either the vaccine-critical or the control site; in the condition where participants had to access both websites, both links were displayed. Once participants had entered the website, they were free to surf for five to ten minutes and read as many pages within the given website as desired. We manipulated focus of search by informing participants that conventional (alternative) practitioners state that the omission (commission) of vaccinations leads to considerable risks. They were asked to test the respective assumption and search for information that helps to answer the question at hand. Approximately one third of participants did not have a directed focus instruction and were thus given no additional information.

After the search, all open websites had to be closed; the time spent on each page of the program was logged in the data file. The dependent measures were repeatedly taken (risk

intentions, fear). Further, participants reported which websites they accessed and evaluated the websites regarding several aspects (how boring, vivid, emotional, rational, personal, scientific, threatening or informative they were). We were mainly interested in characteristics that relate to affect and emotions; to avoid consistency effects, we also included several distracter items. Participants were also asked if they read individuating case information.

Preference for intuition and deliberation scale. At the end of the experiment, we assessed the Preference for Intuition and Deliberation scale (PID, C. Betsch, 2008). The 18-item measure assesses the chronic preference for affect- and cognition-based decision making on two bipolar scales.

Debriefing. As we hypothesized that our manipulation could influence the perception of risk and intentions to vaccinate, we thoroughly debriefed our participants and provided detailed information and further links, including links to websites that are members of the World Health Organization Vaccine Safety Net. Participants were also given the opportunity to send a free-text message to directly express possible opinions and concerns. Those willing to leave their email address took part in a lottery for a 100,- Euro gift certificate.

Results and Discussion

Sample

We carefully reviewed the data set and excluded participants that apparently did not follow the instructions (by entering nonsense letters instead of numbers (N=60), by viewing the treatment websites for less than 4 minutes (N=122), or by visiting websites other than prescribed (N = 10)) The remaining sample consists of 325 participants (mean age = 34.43, $SD = 6.06$). 94.5% were female. 1% of participants had finished lower secondary school, 20.3% secondary school, 24.9% university entrance diploma, 46.8% an undergraduate university degree and 7.1% a doctoral degree. 13.6% of female participants were pregnant at the time of the survey. 92.3% of the total sample had children ($M = 1.50$, $SD = 0.91$). 66.4%

of the participants had children at the age for which the vaccinations of interest are recommended (between 2 and 24 months). Participants frequently read about medical topics on the Internet ($M = 5.46$, $SD = 1.38$) and had previously dealt with the topic of vaccination ($M = 6.32$, $SD = 0.95$).

Manipulation checks

In the vaccine-critical condition, 45% confirmed the occurrence of case-based information, while in the control condition only 5.7% did so ($\chi^2 = 14.73$, $p < 0.001$).

The vaccine-critical website was evaluated as slightly more vivid than the control site ($\eta^2 = 0.02$; $F(1, 221) = 3.32$, $p = 0.07$) as well as significantly more emotional and more threatening; additionally, the vaccine-critical website was perceived as more personal and informative and less scientific and rational than the control site (all $ps < 0.05$, η^2 between 0.04 and 0.3). The two websites were evaluated as similarly boring ($F < 1$). For more detailed information see C. Betsch (2009).

Major Analyses

Main dependent variables in regression analyses were: the change in perceived risk of vaccinating, change in risk of not vaccinating and change in mean intention (Cronbach's alpha for the four intentions regarding different vaccinations was .86, a mean score was calculated). Change was calculated as difference scores (post minus pre).

As predictors we created dummy variables to compare the information environments (Hardy, 1993): the control site served as reference group; we created the variables "vaccine-critical" (vaccine-critical = 1, rest = 0) and "both" (both = 1, rest = 0). The regression coefficients estimate the effect of accessing the vaccine-critical site (or both) compared to the control site. For the focus of search, we used the group that had no specified focus of search as the reference group; the respective dummy-variables are "vaccination risk" (vaccination is

risky = 1, rest = 0) and “non-vaccination risk” (not vaccinating is risky = 1, rest = 0). Thus, the regression coefficients estimate the effect of a directed focus of search as compared to no specified focus.

We generally expected that accessing vaccine-critical websites will increase the perception of risk regarding vaccinations and reduce the perception of risk regarding the omission of vaccinations compared to viewing a control website (Hypothesis 1a). Vaccination intentions should decrease after viewing vaccine-critical content (1b). Hypothesis 2 assumes that focusing on risks to vaccinate /of omitting vaccinations should increase the respective risk perceptions and lower vaccination intentions.

Table 1 shows descriptive data, Table 2 the results of regression analyses.

Changes in risk perception.

The regression on change in perceived risk of vaccinating revealed that accessing vaccine-critical websites significantly increases the perception of risk ($\beta = 0.28$) as compared to surfing the control site and compared to the a-priori judgments. The control site decreased the perceptions of the risk to vaccinate. Contrary to hypothesis 2 search focus did not influence risk perception.

The effect was reversed for the perceived risk of omitting vaccinations: visiting vaccine-critical websites decreased the perceived risk of omitting vaccinations ($\beta = -0.17$); all other predictors were non-significant. Accessing both websites did not significantly raise either risk perception.

Including interaction terms of the dummy variables revealed no further effects for both dependent variables. The effects were stable when we controlled for several variables of personal involvement (preference for medical treatment, time previously spent on the topic of vaccination, emotional involvement in the topic of vaccination and whether the participant has a child aged between zero and two years).

We further examined whether the effect of vaccine-critical web-sites was affected by different levels of involvement by including the respective interaction terms in the regression. For participants who had previously spent a great deal of time thinking about the topic of vaccination, vaccine-critical websites had the opposite effect ($B = -0.49$, $SE = 0.05$, $\beta = -0.19$ for the risk to vaccinate and $B = -0.29$, $SE = 0.13$, $\beta = 0.15$ for the risk of not vaccinating). That is, the perceived risk to vaccinate declined in light of vaccine-critical information when people were highly experienced, whereas the perceived risk of not-vaccinating increased. Thus, experience seems to moderate the influence of vaccine-critical information and helps to discount the acquired information. Accessing vaccine-critical websites still had a significant effect on the change in risk perception ($\beta = 0.27$; $R^2 = 0.12$ for the risk to vaccinate and $\beta = 0.17$; $R^2 = 0.07$ for the risk not to vaccinate).

Changes in intentions to vaccinate. An analogous regression analysis revealed that searching information on vaccine-critical websites lowers vaccination intentions ($\beta = -.24$), even when other sources are considered ($\beta = -0.18$). Even when we additionally considered the influence of perceived risk after the information search, vaccine-critical information negatively influenced vaccination intentions. The results of a repeated measure ANOVA with the intentions for the four single vaccinations as dependent variables indicated that the intentions did not differ significantly between the different vaccinations ($\eta^2 = 0.01$; $p = .10$).

In sum, there is substantial evidence for hypotheses 1a and 1b. Information acquisition on a typical vaccine-critical website significantly influenced risk perceptions regarding the commission and omission of vaccinations and vaccination-intentions in the expected direction. We found no support for hypothesis 2, which expected an influence of search focus on risk perceptions and intentions.

Relation between risk perceptions and intention. The risk of not vaccinating was positively related to the intention to vaccinate, both before ($r = 0.74$) and after the

manipulation (0.73). As expected, the risk of vaccinating was negatively related to intentions, both before (-0.71) and after the search (-0.70, all $ps < 0.01$). The intentions for the specific vaccinations are similarly related to the general risk perceptions; correlations range between |.60| and |.70| before and |.57| and |.69| after the information search. It is noticeable that the risk perception of adverse effects is as strongly related to intentions as the perceptions of the risk of omitting vaccinations.

Exploring possible mechanisms

To test hypothesis 3, we explore the effects of case-based information as well as the effects of elicited affect, emotions, and vividness of the information environment. Since we consider affect to play an important role, we expect a moderating effect of a preference for intuition, as such a preference leads to an increased use of affect in judgments.

Influence of individual case information on risk. We expected that reading individuating case information will influence the risk perception. Contrary to this expectation, the presence of case-information had no direct influence on changes in risk perception. This was revealed by an ANOVA with the presence of case information (as judged by the subjects: yes/no) as between factor ($F_s < 1$ for both risk of vaccinating and risk of not-vaccinating). Further analyses will reveal their indirect influence (see below).

Influence of threat, emotionality and vividness of the websites. In order to assess the relative influence of threat, emotionality and vividness of the pages, we used the variables as predictors in a multiple regression ($N = 324$) with change in risk as criterion. The degree to which the websites were perceived as threatening was the only significant predictor ($\beta = .12$, $t = 1.92$, $p = .056$, $R^2 = 0.02$). The more threatening the websites were perceived, the greater the increase in the perceived risk of vaccinating. For the risk of omitting vaccinations, no such relation occurred. This is plausible, as the vaccine-critical websites publish information about the possible harmfulness of vaccinations, not about omitting vaccinations. The control

site obviously did not publish any affect-laden information regarding the omission of vaccinations. It is noteworthy that website vividness was not evaluated to be significantly different and that vividness did not significantly predict changes in risk perception (correlation between vividness and changes in risk $r = -0.03$). Emotionality also had no significant effect on changes in risk, which suggests that the negative valence of affect (threat) is important in predicting risk perception.

Changes in fear. As the risk-as-feelings approach also expects emotions to be predictors of risk, we explored this relation. As an indicator of emotion elicited by the websites, we assessed the changes in fear of different vaccine-preventable illnesses (e.g. rubella) and alleged side-effects (e.g. neurodermatitis) due to the information search. There was no effect of the independent variables on fear, i.e. the vaccine-critical website did not increase fear of certain illnesses or side-effects.

Thus, compared to the control website, the vaccine-critical site seemed to elicit non-directed, unspecific affect of threatening nature (as the websites were evaluated as more emotional and threatening), instead of creating fear of certain illnesses or events. Threat was significantly related to changes in perceived risk to vaccinate. We therefore use perceived threat as a central variable for further analyses.

Moderating effect of preference for intuition. The degree of perceived threat did not depend on the individual preference for intuition ($r = 0.06$). That is, favoring intuition as judgment mode did not lead to an overall perception of more affect.

To test the moderator effect we used the centered variables threat, preference for intuition, and the interaction of both to predict change in risk perception in a regression analysis. Threat remained a significant predictor ($\beta = 0.12$, $t = 2.23$, $p = 0.026$). Preference for intuition had no effect. As expected, the interaction effect was significant ($\beta = 0.11$, $t = 1.89$, $p = 0.05$). Thus, the more participants habitually relied on affect as a base for judgments

and decisions, the more their judgments regarding vaccinations was affected by threat triggered by the information provided on the websites. For the change in perceived risk of not vaccinating, no predictor reached significance (all t 's < |1|).

Relation between individuating case information, threat and risk. Even though there was no direct relation between the presence of individual case information and changes in risk, case-information could be related to the experienced threat, which influences risk. Figure 1 illustrates the relations in a path model. In the first regression, we regressed threat on having read individuating case information. In the second analysis, we regressed the change in perceived risk of vaccination on the presence of individuating information, threat, preference for intuition and the interaction of the latter two (all centered). The results reveal that reading individual case information is related to an increased perception of threat, which relates to increased risk perception. The relation between perceived risk and experienced threat is especially pronounced for individuals with a high preference for intuition.

Discussion

Our analyses reveal that viewing typical vaccine-critical websites for only five to ten minutes increases the perception of risk regarding vaccinations and decreases the perception of risk regarding the omission of vaccinations as compared to visiting a control site. Moreover, acquiring information about vaccinations on a vaccine-critical website significantly decreased the intentions to vaccinate. This relation between the variables was influenced by affect: Vaccine-critical websites were related to an increased perception of threat, which was at least partially conveyed by case-based information. For individuals who habitually prefer basing their judgments and decisions on affect, the relation between threat and changes in risk perception was even stronger. As the results are based on correlational data, future studies should manipulate critical variables to test the causal relationship implied by the path analyses. The finding, however, already underline the relevance of affect for

changes in risk perceptions and may be interpreted as evidence for the affect heuristic (Slovic & Peters, 2006).

We expected that due to an overweighting of confirming information, the search focus should influence judgments of risk and intentions. However, we did not observe this effect. This might be a result of the specific search environments. The information presented on the two websites was presumably mainly unidirectional. Thus, selecting only information directed toward the risks of omitting vaccinations might simply be impossible on the vaccine-critical website.

The obtained sample was oriented mainly towards conventional medicine and female participants. It is remarkable that accessing vaccine-critical websites affected risk judgments independent of participants' actual medical preferences. Thus, being of conventional orientation is no warranty against the influence of alternative-oriented sources of critical information. In general, however, our findings should be limited to a population with a preference for conventional medicine. Alternative-oriented parents might be especially prone to the influence of vaccine-critical websites, which might have led to an underestimation of the effects in this study. As the sample was recruited in authentic information environments of female health decision makers (mothers), we assume that our results have high external validity. However, we still propose that the relation between the critical variables be assessed in a more representative sample, as well.

As additional factors influencing changes in risk perceptions and intentions, we identified the individual preference for intuition and the experience with the topic of immunization. We consider the influence of the preference for affect-based judgments as a cross-validation of the results that relate affect to changes in risk perception. The moderator effect of experience with the topic was unexpected. It is possible that those participants in our sample who reported having frequently dealt with the topic of immunization were able to discount the

information in their immediate judgments. Having often dealt with the topic implies strong attitudes and/or a large knowledge base, which facilitates discounting dissonant information (Festinger, 1964). Long-term studies should assess, however, whether the discounting of the information is stable over time or whether, in the long run, the risk perception is still affected by the encoded information (so-called sleeper effect; Hovland, Lumsdaine & Sheffield, 1949; Kumkale & Albarracín, 2004).

The results further show that the risks of implementing preventive health behavior should be taken into account as costs of preventive behavior. Beliefs about risks of the preventive action are currently underrepresented in the literature (Brewer et al., 2007). Especially in the field of immunization, applying the preventive action can *cause* adverse events or side-effects. One should therefore extend the cost-component in theories of protective health behavior to health-related costs (Weinstein, 1993) and include beliefs and feelings towards risks of adverse consequences. Future studies should test whether the relevance of health-related costs is restricted to the field of immunization.

Traditionally, health behavior theories have a cognitive orientation; only a limited number consider affective reactions to a stimulus (Peters, Lipkus & Diefenbach, 2006). The discussion of affect as motivator for preventive behavior (Peters et al, 2006) should be broadened to affect as a possible motivator *against* protective behavior. A follow-up to this study with a limited sample of participants revealed first evidence that vaccination behavior was influenced by the internet search during a period of five months after the present study. Fewer participants who perceived a higher risk of vaccinating after the study had their children immunized ($r = -.14, p < 0.05$, C. Betsch & Renkewitz, in press). The perception of being threatened by the preventative behavior should be regarded as something that might reduce the probability of the behavior's occurrence.

Besides exploring the processes by which individuating case information influences risk judgments, it might also be useful to assess strategies that counteract these processes.

Generally, it seems useful to explore conditions that allow for discounting of threatening information (experience with the topic of immunization might be a good starting point, as our data suggest). Official websites and practitioners may want to increase efforts to educate parents in the topic of immunization. However, it seems valuable to keep in mind that not only “cold” knowledge is relevant, but that “hot” feelings of threat, too, are powerful in determining perceptions of risk and may eventually influence behavior.

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Footnotes

1 Links to the study were posted in discussion boards of www.9monate.de and www.eltern.de; published in a newsletter of www.qualimed.de, www.idw.de; and on the “news” website of the University of Erfurt. We gratefully acknowledge their support.

2 We also assessed risk as the estimated probability (as incidence rates \times : 100.000) of the respective illnesses and alleged side-effects. However, the variables turned out to be useless, as the dispersion of the data was very high, leading to the conclusion that quantitative estimates are problematic and highly error-prone in such settings (cf. van der Pligt, 2002). Future studies should assess risk by assessing the probability on a rating scale. We did so in recent studies, which yielded the same effects as presented in this study.

3 The four vaccinations were a combined six-fold vaccination against tetanus, diphtheria, pertussis, haemophilus influenzae b, polio, and hepatitis b; a combined vaccination against measles, mumps, and rubella; a vaccination against varicella; and a vaccination against meningococcus. As these are the recommended and most common vaccinations (by an independent German federal agency) for children between two months and 2 years of age, both websites covered all vaccinations.

Tables

Table 1

Changes in risk perception and intention as a function of search environment and focus of information search

		Search environment					
		vaccine-critical		control		both	
Search focus	Changes in ...	M	SD	M	SD	M	SD
vaccinating is risky	risk of vaccinating	0.400	(1.476)	-0.444	(1.382)	-0.125	(1.238)
	risk of not vaccinating	-0.467	(1.008)	0.056	(0.791)	-0.094	(1.510)
	mean intention	-0.283	(0.811)	-0.014	(0.207)	-0.156	(0.689)
not vaccinating is risky	risk of vaccinating	0.529	(1.637)	-0.500	(1.502)	-0.150	(1.001)
	risk of not vaccinating	-0.294	(1.060)	0.104	(0.928)	0.100	(1.057)
	mean intention	-0.059	(0.364)	0.172	(0.511)	-0.069	(0.663)
no specified direction	risk of vaccinating	0.525	(1.754)	-0.143	(1.287)	-0.167	(1.234)
	risk of not vaccinating	-0.325	(0.944)	-0.086	(0.658)	0.300	(1.264)
	mean intention	-0.231	(0.523)	0.107	(0.390)	-0.125	(0.424)

Table 2

Results of regression analyses on change in perceived risk and vaccination intentions

	Change in perceived risk of vaccinating $R^2 = 0.07$			Change in perceived risk of not vaccinating $R^2 = 0.04$			Change in mean vaccination intention $R^2 = 0.07$		
	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β
(constant)	-0.288	0.175		0.063	0.129		0.078	0.066	
Vaccine-critical	0.857	0.190	0.277*	-0.390	0.139	-0.174*	-0.280	0.072	-0.239*
Both	0.231	0.190	0.074	0.066	0.139	0.029	-0.208	0.072	-0.176*
Vaccination risk	-0.132	0.198	-0.042	-0.118	0.145	-0.052	-0.067	0.075	-0.057
No-vaccination risk	-0.125	0.188	-0.042	0.016	0.138	0.007	0.097	0.071	0.086

Note: The predictors are dummy variables. $N = 324$. * indicates statistical significance on $p < 0.05$ or less.

Figure captions

Figure 1

Path model predicting changes in risk perception (N = 315).

Figure 1

