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Integrating social media features into a cell phone alert system for emergency situations

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Abstract

In times of emergency, people include social networking sites (SNS) in their search for information and support. An online survey with an embedded experiment with two conditions focused on understanding whether and how SNS functions have a positive influence on perceived self-efficacy, risk perception, and reported information sufficiency when integrated into a current emergency alert system like NL-Alert. Participants were randomly assigned to a control condition showing the classical format of NL-Alert or the expanded condition with added SNS functions (a newsfeed and marking oneself as safe). Results show that self-efficacy and risk perception did not differ between conditions. Significantly higher degrees of information sufficiency were reported in the expanded condition. Consequences for emergency risk communication are discussed.

KEYWORDS
app, emergency risk communication, Facebook, information sufficiency, risk perception, self-efficacy, social media, technology, Twitter

1 | INTRODUCTION

Currently, reliable risk information about emergency situations such as fires, flooding or terrorist attacks from sources like the government and disaster management organizations is made available to the Dutch public only when authorities consider it necessary. This information is aimed at preventing material or immaterial damage to people in the affected area by alerting them to the danger and suggesting adequate coping behaviour. Most of the time, it entails a top-down, one-way form of communication (Ter Huurne, 2008) like a warning message on TV or radio. Dutch authorities have already taken big steps towards integrating new technology when they created NL-Alert,[1] a service that informs people nearby an emergency situation by sending a textlike message to their cell phone with information about the emergency and a recommendation on what action the individual on the receiving end can take. This message is sent through cell broadcast which makes it possible to direct the message to people in a specific area (Gutteling, Terpstra, & Kerstholt, 2017). It is free, no subscription is needed (like one needs in other text-based systems), so it is anonymous. Sending a message to a phone, however, is still a top-down, one-way form of communication. The system is similar to the wireless emergency alerts (WEA) that are used in the United States (Bean et al., 2015).

To date, only few studies empirically evaluated mobile device-delivered warning messages (mostly Twitter messages) (Sutton et al., 2014; Terpstra, de Vries, Stronkman, & Paradies, 2012). Bean et al. (2015) reported a study about people's interpretation of WEAs and Twitter-length messages ("tweets") in a virtual situation without an actual emergency. Casteel and Downing (2016) focused on the question whether 90 characters (which is the maximum length of a WEA) have impact on the effectiveness of the risk communication. Gutteling et al. (2017) examined the effectiveness of the NL-Alert system on underlying mechanisms as perceived threat, efficacy beliefs, social

norms, information sufficiency, and perceived message quality (n = 643 who actually received a real-life NL-Alert after an emergency in their environment).

Social network sites (SNS) are one of the fastest growing two-way communication mediums that function online. Two of the largest SNS are Facebook and Twitter (Amichai-Hamburger & Vinitzky, 2010; Hughes, Rowe, Batey, & Lee, 2012). In the Netherlands, Facebook has about 10.4 million users from which 7.5 million use Facebook daily. Twitter showed an average of 2.6 million users from which 871,000 daily (van der Veer, Boekee, & Peters, 2017) and it seems that they will keep on growing. Of course, due to the success of these tools, there has been discussion about whether the sites or specific features of existing sites might contribute to the effectiveness of emergency risk communication (Veil, Buehner, & Palenchar, 2011). Not only the potential of these features, but also doubts about issues like trustworthiness and privacy[2] play a role in these discussions. At this point in time, we are not aware of any empirical studies looking at the additional value of SNS features or at its potential risks in emergency warnings.

In the light of these discussions, it is not self-evident that the additional features of SNS will increase the effectiveness of a tool like NL-Alert. Therefore, in this study, we focus on the following question: Will integrating social media features into current cell phone alert system efforts like NL-Alert help people in their self-efficacy, in risk perception, and in gaining information sufficiency compared to an NL-Alert message without social media features?

2 | THEORETICAL BACKGROUND

2.1 | *SNS in emergency risk communication*

Research shows that people in stressful/emergency situations tend to look for information and support (Jurgens & Helsloot, 2018; Pettigrew, Durrance, & Unruh, 2002; Ter Huurne, 2008; Ter Huurne & Gutteling, 2009). Preferably, this is information that is easily accessible so that people can deal with uncertainty, time pressure or dangerous situations that might arise (Pettigrew et al., 2002). On network sites like Facebook and Twitter, information is easily accessible. Next to this, on social media, you have a direct connection to the people you care about which in turn gives you easy access to support (Cheung, Chiu, & Lee, 2011; Steinfield, Ellison, & Lampe, 2008). This suggests that using social media in risk communication indeed could be promising as was concluded after an elaborate literature review by Jurgens and Helsloot (2018). The Los Angeles Fire Department, for example, already uses SNS in their communication efforts (Latonero & Shklovski, 2010). The use of Twitter makes it possible for them to have easily accessible, interactive, two-way communication since being part of the conversation is now available for anybody. Next to their new availability for conversation, they are also able to provide information at the precise moment an incident occurs. Messages the fire department sends out vary from responses to questions on Twitter to updates on the status of a fire in real time. In fact, many have argued and found that in a large variety of emergency situations, the use of social media is quite common (Jurgens & Helsloot, 2018; Merchant, Elmer, & Lurie, 2011). During the 2009 influenza pandemic, Twitter was used to inform people on where the vaccine was available; the 2010 Deepwater Horizon oil spill in the Gulf of Mexico resulted in people tweeting photographs of oil-covered birds and so giving real-time information on the state and scope of the disaster (Merchant et al., 2011).

It seems that Facebook also recognizes the role they play in disaster situations. Analysing the experiences with Facebook at an emergency (the school shooting at Virginia Tech in 2007), it became clear that this tool played a major role during the shooting and in the aftermath, among others with posting of RUOK and IMOK messages (i.e., Are you Ok? and I'm Ok). Facebook was also important in the identification of victims (Palen, Vieweg, Liu, & Hughes, 2009). Alongside the regular uses of social media, Facebook developed a feature especially designed for users in an emergency situation. Based on their location and the amount of messages being posted about a disaster, Facebook introduces members to Safety Check (Facebook, n.d.). Just two examples of incidents where this feature was activated are the terror attack on Westminster in London 2017 and the earthquake in Nepal in 2015. People at these disaster sites were, through Facebook Safety Check, able to mark themselves as being "safe" which was afterwards posted to the newsfeed of all of their FB friends. Furthermore, this Safety Check feature gives members the possibility to give or look for help by providing a map with the location of help posts.

When we look at the needs SNS fulfil, Shao (2009) mentions a number of variables that seem to be in play such as fulfilling information, entertainment, and mood management needs. In concurrence, we see that social media indeed does more than just fulfil social needs. During breaking news events, for example, it already seems to play an important role in sharing information. Non-professionals are often already on the ground and can share eye witness reports, photographs or videos of the event (Diakopoulos, De Choudhury, & Naaman, 2012). Latonero & Shklovski (2010) state that sites like Twitter give individuals the ability to broadcast and exchange small amounts of information with large audiences, regardless of distance, and all this in a timely manner. These options seem obviously useful during times of emergency, as information changes unexpectedly and needs to be cast around to the public rapidly. SNS thus indeed seem a promising means for communication efforts.

2.2 | Information sufficiency in emergency situations

Not knowing what is going on and not having control over a situation is a cause of stress (Brysbaert, 2006). In an emergency where people have no control, they will, as mentioned earlier, search for information and support (Pettigrew et al., 2002; Ter Huurne, 2008; Ter Huurne & Gutteling, 2009). People seek for this information to reduce uncertainty (Jurgens & Helsloot, 2018; Ter Huurne, 2008). Modern research in this field focuses on a more bottom-up approach where users' needs are considered. In this research, the concept of

information sufficiency is introduced as the gap between the information someone thinks he or she has and the information one thinks he or she needs to adequately deal with the situation (Ter Huurne, 2008; Griffin, Neuwirth, Dunwoody, & Giese, 2004). Since finding sufficient information in an emergency is time sensitive, the easily accessible, real-time information that social media provides can be especially helpful to increase information sufficiency.

2.3 | Self-efficacy and emergencies

When one believes to have sufficient information to deal with a situation, this logically strengthens one's feeling of control. Having more knowledge about what is going on thus influences the belief that one can actually deal with the situation. Bandura (1997) explained that this belief to deal with a situation yourself is called self-efficacy. Efficacy can be seen as communal or individually activated processes that seek to achieve an intended effect (Sampson, Raudenbush, & Earls, 1997). This efficacy can, but does not have to, concern peoples' own capabilities. If efficacy touches on one's own skills, Bandura (1997) defines it as self-efficacy: the "belief in one's capability to organize and execute the action required" and thus to start the process or act yourself (as cited in Ter Huurne & Gutteling, 2009). This leads us to believe that for people to decrease their stress levels and for them to take control of an alarming situation, it is important that they find sufficient information in a timely manner. We expect that social media can provide this timely information. With the addition of social media features to emergency risk communication (e.g., to tools like NL-Alert), people will therefore feel strengthened in their self-efficacy.

On the other hand, next to having sufficient information, self-efficacy also seems to be related to the perception people have of a risk. How people perceive a risk is dependent on numerous variables which can be divided into emotional and rational determinants (Slovic & Peters, 2006; Slovic, Finucane, Peters, & MacGregor, 2004). Instinctive and intuitive reactions (feelings) to risk exist and a more logical, analytical assessment of risk (rational)—together, these are responsible for risk perception. According to the extended parallel process model (Witte, 1994), if people perceive the risk as serious, the situation can go two ways and which way it goes depends on their efficacy. People can choose to control their fear for the risk or they can choose to control the threat itself. Controlling your fear leads to avoiding the problem ("this is not a problem for me"). However, when people have a high self-efficacy, they are more likely to choose to control the threat itself and perform the required actions to make sure they are safe (Witte & Allen, 2000). So a person feeling well and performing the desired self-protecting behaviour all seems to derive from the amount of information that is available, their self-efficacy, and their risk perception. Since we expect the addition of social media features to influence information sufficiency and self-efficacy, it is interesting to test as well how the related concept of risk perception is affected by added social media features.

In this study, we therefore explore the integration of social media features (a newsfeed and marking oneself as safe) into an existing alert system for emergency situations (NL-Alert) by creating a new format and measuring the self-efficacy, risk perception, and information sufficiency. This leads to the following question: Will participants report different levels of self-efficacy, risk perception, and information sufficiency in a condition where social media features are integrated from a condition that provides no additional social media features (i.e., the current NL-Alert communication)?

3 | METHOD

3.1 | Participants and design

The survey was distributed through various social media sites, and participation was on a voluntary basis. In total, 76 individuals participated in the study.[3] The group that provided full information on gender, age, and education consisted of 29 men and 37 women (M_{age} = 28.66, SD = 10.08) and scored relatively high on education (secondary education 23%, secondary vocational education 6.8%, higher professional education 25.7%, academic education 35.1%). Two participants were excluded from the 76 participants; one indicated that the questionnaire was not understood, and the other participant filled in the same answer everywhere and could thus be discarded because of suspected response bias. The study was designed as an online survey with an embedded experiment that consisted of two conditions: a control condition (showing the NL-Alert as it currently is) and an expanded condition (showing NL-Alert with the added functions of marking yourself as safe and the newsfeed function). All participants were randomly assigned to one of the two conditions. To check the randomization, we conducted a few analyses; an independent-samples t test on age, $t(66) = 0.51$, $p = 0.61$, showed no significant difference, and a chi-square test on education χ^2 (3, $N = 67$) = 1.699, $p = 0.637$ and on gender χ^2 (1, $N = 66$) = 3.021, $p = 0.08$) also showed no significant difference. So the conclusion is that the randomization was successful.

In addition, we performed post hoc power analyses to check whether the sample size of 74 participants was sufficient to achieve acceptable levels of power for the effects we observed in this study. Using the G*Power program (version 3.1.9.2; Faul, Erdfelder, Buchner, & Lang, 2009), we assessed the achieved level of power with the (one-tailed) t tests we conducted (see below) to compare two independent means (i.e., comparing the two conditions with $n = 43$ and $n = 31$), given an alpha level of 0.05 and given the smallest effect size for an effect we observed in this study (Cohen's $d = 0.63$). Given these specifications, the achieved level of power for this effect was 84.6%, which is above the conventional and desired power level of 80%. Thus, from this, it follows that for the effects we observed in this study, the sample size of 74 participants was sufficient to achieve an acceptable level of power.

3.2 | Procedure

The survey took place online. Participants were able to open and complete the survey in their own time and on a desktop computer

as well as a mobile phone or tablet. In both conditions, participants were welcomed and asked to digitally accept the informed consent form. After accepting this, they were introduced to the concept NL-Alert, so any existing, a priori gaps in knowledge between participants would be resolved. Participants were then presented a hypothetic scenario in which the respondent was instructed to envision being in a situation where there is a chemical fire nearby. First one of the two control variables (intended information-seeking behaviour) was measured. With this control variable, we wanted to test for individual differences in behaviour. After this control variable was measured, a video and an image of a phone with the NL-Alert message were shown, comprising the control and expanded condition. Second perceived usefulness was measured, also a control variable. Then, the main dependent variables were administered (self-efficacy, risk perception, information sufficiency, need for information). At the end of the survey, participants were thanked and debriefed.

3.3 | Experimental manipulation of extra SNS functions in alert system NL-Alert

In both conditions, participants were presented with a video and an image of a phone with an NL-Alert message popping up about a local chemical fire resembling a message that would actually be used by the government. All visual materials were created by the first author. The video showed the actions possible, to create a greater understanding of how NL-Alert would work in reality. In the control condition, the NL-Alert message was based on the format of NL-Alert as is (see Figure 1 and https://youtu.be/yDF7JLksChs).

The expanded condition provided the same pop-up message but this time with the new functions of marking yourself as safe and a newsfeed option (see Figure 2 and https://youtu.be/I_gxz3c55g0).

Since the functions in the expanded condition were unknown to participants, they were further explained in the survey. The initial NL-Alert message and the disaster presented were the same for both conditions.

3.4 | Measures

The survey consisted of 25 items. To check whether a priori information needs were comparable between groups, participants were first asked three questions about their intended information-seeking behaviour (i.e., "When there is a chemical fire nearby, I try and find as much information as possible"). The questions asked were based on the questionnaire proposed in Ter Huurne (2008) and together formed a reliable scale (Cronbach's α = 0.70). Hereafter, the stimuli were shown (i.e., the control or expanded condition). Then, a measure of perceived usefulness was administered among participants (i.e., "NL-Alert is useful when I want to lower the risks that are threatening to my safety"), to make sure that the additions to NL-Alert would not result in a lower usability. The five questions that comprised perceived usefulness were based on Kwahk and Lee

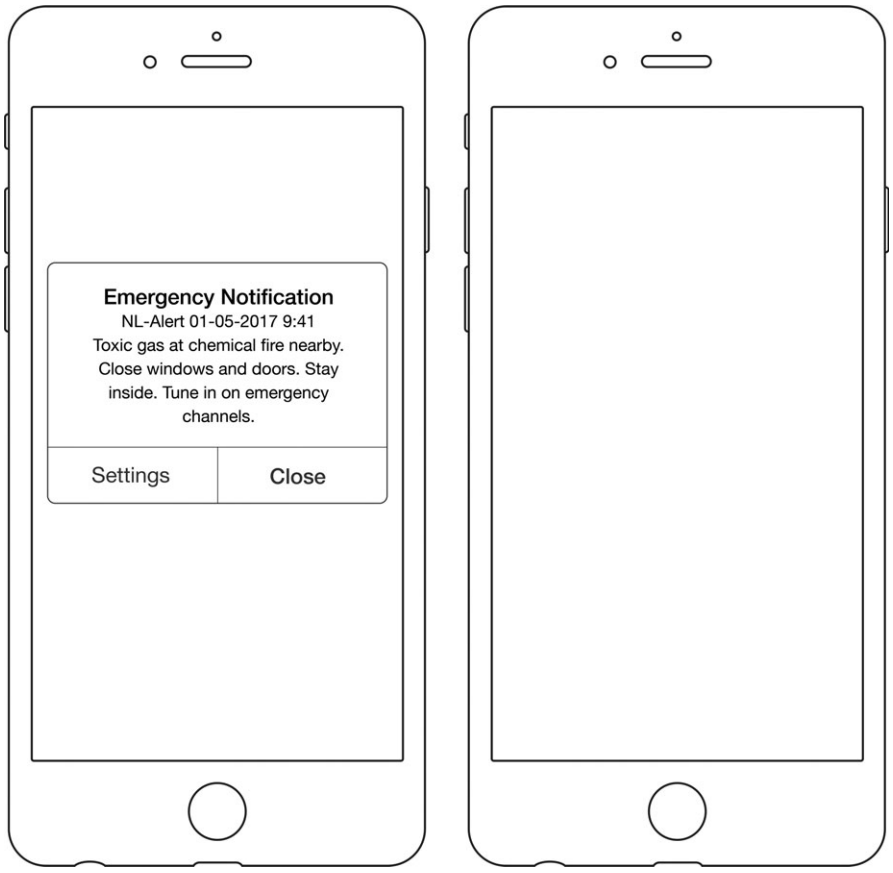

FIGURE 1 Classic NL-Alert format. The message states: "Emergency NL-Alert (time 9.41, date 01–05–2017), toxic chemicals at a fire nearby. Close windows and doors, stay inside and tune in on an emergency broadcast station (RTV)." Participants see the image and can close it

FIGURE 2 Expanded NL-Alert format. The message is the same as in the classical condition. Added here are the options to call for help, to mark yourself as safe to five "in case of emergency" numbers, and to read a newsfeed constructed from reliable sources

(2008) and together formed a reliable scale (Cronbach's α = 0.77). Third, self-efficacy (i.e., "With this information I can protect myself against the possible risks of a chemical fire") and risk perception (i.e., "When there is a chemical fire nearby I am highly susceptible to risks"). Both scales were measured with three questions. The questions measuring self-efficacy were based on Gutteling et al. (2017) and together formed a reliable scale (Cronbach's α = 0.73), and the questions measuring risk perception were based on Gutteling et al. (2017). In their research, this scale was tested in multiple samples resulting in Cronbach's alphas of α = 0.65, 0.67, and 0.56, respectively. In the current study, the scale scored moderately (Cronbach's α = 0.54). Lastly, information sufficiency was measured with three questions (i.e., "After getting the NL-Alert message I know a lot about the subject chemical fire") which were based on Ter Huurne (2008) and formed a reliable measure with an Cronbach's α = 0.75. There were some alterations made to the non-specific information in the existing questions to achieve relevance to this specific scenario (i.e., "I should know everything about changes or accidents regarding this topic in my surroundings" was changed into "I should know everything about changes or accidents regarding chemical fires in my surroundings"). All aforementioned items were asked on an eight-point slider scale (0 = do not agree, 7 = agree).

Next to the standardized questions about information sufficiency, there were two questions added that asked the participant about their additional information needs. On an eight-point scale, people were asked whether or not they felt the need to look for additional information. Next to this, they had the option to, in an open text field, explain which information they would seek for and where. Scale items were compared between conditions with the help of independent-samples *t* test. The data that resulted from the open question were labelled, categorized, and then reduced to central themes (i.e., severity).

4 | RESULTS

In this study, participants self-reported on self-efficacy, risk perception, information sufficiency, and an added question on the need for additional information. To examine whether constructs correlated, a bivariate Pearson's correlation analysis was conducted. Self-efficacy showed a medium correlation with information sufficiency $r(72) = 0.400$, $p < 0.01$, but no significant correlation emerged with risk perception $r(72) = 0.035$, $p = 0.765$. This means that when people indicate high levels of self-efficacy in protecting themselves against the potential risks of a chemical fire, they also score themselves higher on information sufficiency in relation to chemical fires. No significant correlation was found between self-efficacy and the added question on need for information $r(72) = 0.041$, $p = 0.726$. Risk perception did not correlate significantly with any of the other constructs (see Table 1). Information sufficiency showed, aside from the correlation with self-efficacy, a medium negative correlation with the added question on need for information $r(72) = -0.331$, $p < 0.01$. This means that when people scored themselves higher on information sufficiency in relation to chemical fires, they also indicate having a lower need for additional information regarding such fires (for a summary of the correlations, see Table 1).

TABLE 1 Correlations between variables

Variables	1	2	3	4	5
1. Self-efficacy	–				
2. Risk perception	0.04	–			
3. Information sufficiency	0.40**	0.01	–		
4. Need for information	0.04	0.13	−0.33**	–	
Control variables					
5. Intended information-seeking behaviour	0.21	0.43**	0.06	0.37**	–
6. Perceived usability	0.78**	0.15	0.47**	0.02	0.29*

*Correlation is significant at the 0.05 level (two-tailed).
**Correlation is significant at the 0.01 level (two-tailed).

4.1 | Intended information-seeking behaviour

First, the information-seeking behaviour of participants was compared between conditions. This construct was asked beforehand to make sure the participants did not differ significantly on their need for information as this could skew the results. Statistically, there was no significant difference between the participants in the control condition (M = 4.53, SD = 1.36) and the expanded condition, M = 4.15, SD = 1.59; $t(72) = 1.09$, $p = 0.277$. Participants did thus not differ in their indented information-seeking behaviour between conditions before being exposed to the video clips in both conditions. All means and outcomes of *t* tests of all dependent variables are summarized in Table 2.

TABLE 2 Participants' scores on self-efficacy, risk perception, information sufficiency, need for information, and control variables

	Control condition		Expanded condition		Difference between conditions (*t* test)	
Main measures	*M*	*SD*	*M*	*SD*	*T*	*p*
Self-efficacy	4.58	1.30	4.96	1.43	−1.18	0.244
Risk perception	3.61	1.36	3.70	0.98	−0.33	0.742
Information Sufficiency	1.78	1.35	3.08	1.25	−4.20	0.000*
Need for information	6.05	1.41	5.07	1.71	2.70	0.009**
Control measures						
Intended information-seeking behaviour	4.53	1.36	4.15	1.59	1.09	0.277
Perceived usefulness	4.63	1.15	4.99	1.17	−1.30	0.199

Notes. Means derived from an eight-point scale 0 = disagree, 7 = agree.
*Significant at the $p < 0.05$ level. Large-effect Cohen's $d = 0.995$.
**Significant at the $p < 0.05$ level. Middle large-effect Cohen's $d = 0.63$.

4.2 | Perceived usefulness

In both conditions, perceived usefulness was measured to make sure that the alterations to NL-Alert did not affect the perceived usability of NL-Alert as this could influence the results. Both conditions scored above average on an eight-point scale. The control condition showed a perceived usefulness that was slightly lower (M = 4.63, SD = 1.15) compared to the expanded condition (M = 4.99, SD = 1.17). This difference was not statistically significant however, t (72) = −1.30, p = 0.199, meaning that the additions to NL-Alert did not result in different perception of usefulness between conditions.

4.3 | Self-efficacy

Participants reported slightly lower levels of self-efficacy in the control condition (M = 4.58, SD = 1.30) compared to the expanded condition (M = 4.96, SD = 1.43), but the difference was not statistically significant, t(72) = −1.18, p = 0.244. Thus, unexpectedly, participants did not report feeling more efficacious because of the alterations in NL-Alert.

4.4 | Risk perception

Participants indicated a slightly lower risk perception in the control condition (M = 3.61, SD = 1.36) compared to the expanded condition (M = 3.70, SD = 0.98). The two conditions did not differ significantly however t(72) = −0.33, p = 0.742). This means that the expanded NL-Alert did not result in a difference in risk perception.

4.5 | Information sufficiency

As expected, participants exposed to the classical format of NL-Alert as shown in the control condition scored significantly lower (M = 1.78, SD = 1.35) than participants in the expanded condition with the extended version of NL-Alert, M = 3.08, SD = 1.25; t (72) = −4.196, p = 0.000; Cohen's d = 0.995. The data thus suggest that the additions to NL-Alert had a large, positive effect on the reported information sufficiency, although both means are still below average on an eight-point scale.

4.6 | Need for information

The answer to the question of whether or not the participant would look for additional information also differed significantly between conditions. The control condition (M = 6.05, SD = 1.41) scored higher than the expanded condition, M = 5.07, SD = 1.71; t (72) = 2.70, p = 0.009; d = 0.63. In the expanded condition, participants thus agreed less with the statement "after receiving this NL-Alert message I would feel the need to look for additional information" than participants in the control condition; this was a middle large effect. It should be noted, however, that both means were above average on the eight-point scale given, indicating that participants in both conditions were still inclined to seek additional, extra information.

4.7 | Additional measures

After labelling, categorizing, and grouping the answers given on the open question (with respect to which information participants would seek for and where), they were interpreted. Most participants in both conditions stated, when talking about information sources, that they would look for information on the Internet. Few people reported other sources like the TV, radio or teletext. When addressing the kind of additional information people would look for, there seemed to be some difference between conditions. In the control condition, more people reported a need for specifications about the disaster ("I want to know what exactly went wrong and which chemicals are in play") and a desire for information about the severity ("I would look up how bad it really is"). This suggests a slight difference in the type of information participants still require after getting the NL-Alert message. In the control condition, people also asked for more factual information about the disaster itself. Participants mentioned the need to know "what is a chemical fire?" and "which chemical materials are in play?". Answers from participants in the expanded condition seemed to include more need for concrete information about appropriate actions and future prevention. Some examples of the information participants requested are "do I need to warn kids playing outside?" or "if I'm in an unknown area, where can I go for shelter?".

In the light of the ongoing discussion about potential negative or positive evaluations of the added SNS features, we also checked the respondents' answers to the open-ended questions for such indications. In general, respondents gave little feedback on the tools, and one person gave a clarifying remark about the combination of NL-Alert and added SNS features: "The news overview seems a bit limited so I personally would always look at Twitter to see what happened there and possibly on news sites, but it does give a first look at a possible disaster. I do not think you know much about the subject at once but that you have enough information to see what the seriousness is and what you have to do practically, that seems to me the most important thing."

5 | CONCLUSION AND DISCUSSION

Since the introduction of the Internet, people have been choosing SNS for their communication efforts. These platforms give people the option to, without any barriers, exercise control over what information to share. The ease of use, real-time information and feeling of control that comes with the use of SNS seem promising in times of emergency. In this study, we aimed to clarify whether integrating social media features into current cell phone alert system for emergency situations like NL-Alert could help people in their self-efficacy, in risk perception, and in gaining information sufficiency. To test these effects, we randomly exposed half of participants to an expanded NL-Alert message about a chemical fire nearby which presented the SNS features of marking oneself as safe and a newsfeed; the other half of participants received the traditional NL-Alert message without these SNS features added. With this design, we

intended to determine whether the addition of SNS features would positively influence self-efficacy, and information sufficiency, and would reduce risk perception.

The results showed that the addition of social media features did not cause any differences in reported self-efficacy and risk perception. There was, however, a significant increase in reports on information sufficiency. People thus do not seem to experience that the added functions would help them in their self-efficacy or that these additions influence their risk perception, but it does to a certain extent help the fulfilment of their information needs. These needs are among others reliable additional information from trusted sources about the severity of the emergency and the necessity of adaptive actions and the possibility to inform with one click people that are indicated as "persons to notify in case of an emergency." The effects of the additional features therefore seem to have an influence on specific variables only.

Earlier research gives reason to assume that social media features do indeed help people in times of risk and crises (Jurgens & Helsloot, 2018). Even though the current study was exploratory (as far as we know the first of its kind), it shows that the addition of social media features does increase information sufficiency and the answers to the open question suggest that possibly, this even results in less insecurity about what is happening. In turn, this positive effect on "knowing what is going on" could cause more awareness about what might be appropriate action to take.

There are some possible explanations of why not all expected results were visible in our study. The first explanation of why there is no significant result on self-efficacy and risk perception could be that the manipulation of additional information, although having an influence on the reported information sufficiency, would not have been sufficient to influence processes that act upon risk perception and self-efficacy. The fact that information sufficiency did significantly improve in our expanded condition leads us to believe that our addition does provide the users with something that they are looking for. Adding to this idea is our cautious interpretation of the results from our open question which suggests that our study might have touched upon outcomes that need further research. That is, in our expanded condition, less people asked for basic and factual information about the disaster. We could speculate that there might be different levels of information people need. It may well be the case that our expansion touched upon a first level of information that focuses on basic knowledge about what is happening but that it did not suffice in more detailed or visual information on a higher level. This could be the reason why efficacy and risk perception were similar in both conditions and why people still report that they would look for additional information online. One reason for that might be the lack of insight in other people's coping behaviour. With warnings via the mobile phone, it is possible that people receive the extended NL-Alert in a situation when no other people are present to immediately discuss options or exchange risk perceptions. Social media might replace observing other people's coping behaviour in real life. Perhaps, a future study with a control group that receives no information could indicate whether the two present conditions would lead to an increase/decrease of self-efficacy or risk perception.

Second, one could argue that our survey was not conducted in a way that could measure true self-efficacy and risk perception. Self-reports are known to not consistently show correlations with behaviour (Pryor, Gibbons, Wicklund, Fazio, & Hood, 1977), and when one is using a computer or a phone in a safe environment, it might be impossible to determine one's self-efficacy as it would be in times of emergency. Even though the ecological validity of self-reports and an imagined scenario can thus be doubted, at this time it is one of the most accessible indications we have to further develop communication risk efforts and it is frequently seen as an effective measure (Amichai-Hamburger & Vinitzky, 2010; Gutteling et al., 2017; Ter Huurne, & Gutteling, 2009).

5.1 | Future research

For future research, we suggest a novel approach to this topic. Our main recommendation would be that different and more realistic scenarios should be tried out. To discard the doubt about ecological validity, we propose to create a scenario that is more realistic with the help of, for example, virtual reality. In virtual reality, participants could experience sounds and visual stimuli comparable with those experienced in a real-life emergency, which may therefore lead to feeling more *present* in the emergency (VR) situation compared to the emergency scenario approach adopted in this study (Bakker, Kerstholt & Giebels, 2018; van Gelder et al., 2018). This heightened presence felt in the emergency through the VR approach could trigger different processes in the brain and perhaps tap into the sympathetic nervous system (responsible for the fight-or-flight response) which our manipulation probably never did. Although VR technology is not yet accessible for all researchers and it is still not "the real deal," it could be promising in bringing us closer to true data.

In addition, for future research to improve our manipulation, we suggest splitting the two social media features and creating four conditions instead of two (a control condition, a condition where the newsfeed is added, a condition where "marking oneself as safe" is added and a last condition where both features are added). Splitting these features gives the possibility to isolate the specific effects of each feature and thus gives new insights. Next to this, it could be useful to think of new perspectives on integrating social media features. It should be considered to try out other SNS features or, when proven not effective, whether or not integration of these features is desirable at all. Perhaps, a multichannel approach, where NL-Alert and SNS efforts are used alongside one another, could offer a solution.

We suggest that future research looks further into this subject and explores the information needs and behaviour of people in times of risk and directly thereafter. This information can be used to create a design that positively influences self-efficacy and risk perception. As Jurgens and Helsloot (2018) and Merchant et al. (2011) state, the use of social media during disasters can be useful, and therefore, we

propose that risk communication efforts that use modern technology deserve more attention in scientific research in general. Technological developments in the past resulted in most people having a mobile phone at hand every minute of every day. These results have implications for enhancing emergency communication services. Using a mobile device to warn and simultaneously provide access to essential services might reduce the burden on all people involved.

ENDNOTES

[1] NL is short for the Netherlands.

[2] The recent Facebook Crisis is an example of concerns related to privacy.

[3] Of 10 participants, neither gender, age or educational level was recorded.

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