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Edited by
R.P. Thornton

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Welcome from Editor

It is my pleasure to bring to you the compiled papers from the Science Day of the AFAC and Bushfire CRC Annual Conference, held in the Sydney Convention Centre on the 1st of September 2011.

These papers were anonymously referred. I would like to express my gratitude to all the referees who agreed to take on this task diligently. I would also like to extend my gratitude to all those involved in the organising, and conducting of the Science Day.

The range of papers spans many different disciplines, and really reflects the breadth of the work being undertaken, The Science Day ran four streams covering Fire behaviour and weather; Operations; Land Management and Social Science. Not all papers presented are included in these proceedings as some authors opted to not supply full papers.

The full presentations from the Science Day and the posters from the Bushfire CRC are available on the Bushfire CRC website www.bushfirecrc.com.

Richard Thornton

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Warning Fatigue: what is it and why does it matter?

An exploration and critique of the literature

*Brenda Mackie - University of Canterbury, School of Social and Political Sciences
Affiliated with Joint Centre for Disaster Research, Massey University, Wellington, NZ,
<http://disasters.massey.ac.nz/>
email author: brenda.mackie@canterbury.ac.nz*

Abstract

'Cry-wolf' syndrome and 'warning fatigue' effect are generally recognised terms for cynicism or apathy that have been thought to result from being 'over-warned'. It has been anecdotally observed in disciplines of health, meteorology, military, emergency and disaster management. There is an assumption by end-users that warning fatigue not only exists but is a problem, yet much of the literature calls the phenomenon a 'myth', whilst at the same time acknowledging that false alarms have been observed to lead to public desensitization, emotional adaptation and risk normalization.

Overwhelmingly, the literature concentrates on disasters that appear and disappear quickly, ignoring disasters, like bushfires, which have a much longer lead time. This paper suggests that these two scenarios need to be differentiated and, underscored by empirical research a reconceptualization of warnings (and the public's response to them) developed.

Introduction

When individuals are exposed to recurring warning messages about an event which then does not eventuate, folklore like the fable 'The Boy Who Cried Wolf'⁴³ says that people become tired of hearing warnings. The story goes on to describe how the villagers turn off and become desensitised to the threatened danger, thereby endangering themselves even more. Over the years the term 'cry wolf' has morphed into a myth about a mischievous trickster who warns about a danger that does not exist. However, in the original story, the boy saw the wolf creeping near to the sheep and cried out to the villagers to come and help, and the noise the villagers made when they came out to protect the sheep scared the wolf away. Because the villagers did not see the wolf they thought he did not exist so after several repetitions where the wolf appeared, the boy warned, the villagers came to help and the wolf ran away, the villagers no longer came out to help, eventually allowing the wolf to capture and make off with the sheep. Through the telling and retelling of this story, the meaning or moral of it has changed. Whereas it used to mean that 'even if you do not listen to the boy, sooner or later he will be right', the dominant interpretation of the 'cry wolf' moral in the 21st century's is that the boy is a liar.

This paper examines the existing literature which has referenced or researched the phenomena of warning fatigue or the 'cry wolf' effect, and critically evaluates the validity of the research, highlighting inadequacies and gaps. This will be done by explaining why warning fatigue is important to both emergency managers and the public alike, briefly exploring the meanings of warnings (in a disaster-specific context), and the public's response. Existing literature is examined and constructs of warning fatigue hypothesised. As the phenomenon of warning fatigue has not been empirically conceptualised by any literature or research to date, this paper serves as a starting point for thinking about what may comprise warning fatigue; for this reason it is intentionally broad in its approach.

Why does it matter?

The meaning of warning fatigue has become a 'taken-for-granted' phenomenon and is regarded as conventional wisdom. For example, in 2010, the US National Weather Service stated it was actively seeking to reduce the problematic false alarm rate (FAR) related to weather warnings, because of anticipated community complacency (Barnes et al., 2007).

Rhatigan, Barnes and Grunfest (2004) surveyed emergency managers after Superstorm of '93', and found that 'those issuing warnings may be more reluctant to issue warnings for the fear of issuing a false alarm' (Grunfest and Carsell 2000; Weaver et al cited in Barnes et al, 2007:1143). Sandman (2006) acknowledged the dilemma of emergency officials when he says that it is hard for them to know just how aggressive to be when 'sounding the alarm' (p.1) as they have a two-fold problem; avoiding the accusation of panicking the public whilst running the risk of under-preparing them at the same time.

⁴³ 'The Boy Who Cried Wolf', one of more than 655 fables, supposedly written between 620 and 560 BC by a Greek slave and story-teller called Aesop

In a paper presented at the 2010 AFAC conference, Principal research scientist for CSIRO⁴⁴ Dr Garry Cook concluded that managing the 'cry wolf' effect was one of the three main recommendations that should be addressed in order to reduce residual risk from bushfires in the Australian context (Cook, Bradstock and Williams, 2010). At the 2011 AFAC conference when, Claire Johnson from the School of Psychological Sciences at La Trobe University explained how bushfire fighters make decision in worst case scenarios and identified warning fatigue as a one of seven factors that act as a barrier to effective management.

Warning fatigue is frequently cited as an issue in research wanting to manage public response to disasters, warnings and to provide solutions in how to reduce risk and enable effective preparedness; this is despite there being no definitive framework with which to measure or describe the phenomenon. Emergency managers and the public engage in debate about (and contribute to) the 'cry wolf' discourse, however they do so without knowing what it is or whether it is real; the purpose of this paper is to explore and reify, or make concrete, the phenomena of warning fatigue.

Warnings

Much of the emergency management literature describes optimal warnings as 'timely and effective' however, the 'timely' component for these best-practice warnings is seldom quantified.

A warning can mean different things depending on the threat: one is that the danger is real, its happening or arrival is certain and the timing can be predicted accurately; for example cyclone warnings where the equipment to predict these is sophisticated and highly developed. Another warning possibility is that the danger is real, but the arrival is in question and the timing is anyone's guess; health warnings about severe infectious outbreaks fall into this category. Volcanic eruptions are an example of a warning where the danger is real but its arrival is in doubt; geologists can observe abnormalities in the way a volcano is behaving, may even see some eruption evidence, but cannot predict how the volcano will behave. Yet other warnings are about dangers which may or may not exist (right now), may not arrive at all nor in the manner that is warned about. Bushfires, earthquakes, tsunamis all fall into this category – disastrous events involving these hazards have happened in the past, and because of a particular location or season it is possible it may happen again *but thus far*, nothing has happened. Even so, these dangers are continually warned about and preparation for them is recommended.

Bushfire warnings are most often issued in the absence of an actual fire. This is different from weather warnings which are issued based on sophisticated meteorological data that can be seen and plotted. Of course, high temperatures alone can be weather warnings, but a bushfire needs a combination of multiple factors coinciding over months and years to produce a potentially life-threatening bushfire. These include; very high temperatures, very low humidity, strong wind conditions, high fuel load, low ground moisture and specific terrain geography.

⁴⁴ The Commonwealth Scientific and Industrial Research Organisation is Australia's national science agency and one of the largest and most diverse research agencies in the world.

After a warning

What happens after a disaster warning of some magnitude is issued; more importantly, what do people typically do? Nigg (1995) explains that after a warning has been issued, life continues to be regarded as normal or not life-threatening, that is, *until* social and sensory cues demonstrate anything to the contrary. Interpretation of warning messages always occur within peoples 'frames of normal expectations' and in order for people to take action, this 'normalcy bias' needs to be overcome (p.374).

Literature shows that people most often revert to their own evaluation of their environment, checking the temperature, wind direction or horizon, looking for clues that will either confirm or invalidate the warning. Social networks come into play, where neighbours, or those acquaintances nearby are called upon to provide more cues not immediately available. To the observer, it may seem somewhat chaotic, but this 'social disorganisation', according to Turner (1984) is common and not necessarily unintentional or irrational, as it often involves trying to get to a safer location, find and reunite families and gather up frightened pets. Of course, some people seem to do nothing, but research has shown that even when people go about their daily routines, they have paid attention to the warning; they have just reacted to it in a different way.

Short lead time (SLT) and Long lead time (LLT) disasters.

Overwhelmingly, literature which refers to the myth of 'cry wolf' all do so on the basis of short-lead time (SLT) disasters. These disasters are typically weather related and come and go within a week. However, all disasters are not the same.

Janis (1962) was the first to make a distinction between two different types of disasters and posits that there is a marked difference between the reactions of people to warnings about precipitant or 'short-lead-time' disasters and those in non-precipitant or 'long-lead-time' situations. He cites the example of the great Kansas City flood and subsequent fire of 1951 where homes of 20,000 residents were damaged or destroyed. A major reason that people did not evacuate was a series of preliminary communications issued prior to the actual crisis; 'the very fact that it was possible to issue warnings long before the danger was imminent made possible a gradual, easy adaptation to the approaching danger, but at the same time, rendered the warnings less effective' (University of Oklahoma Research Institute, 1952:18., cited in Janis, 1962:79).

Drabek's (1999) research following Hurricanes Bob (1991), Andrew (1992) and Iniki (1992) showed that, amongst other factors, two event characteristics constrained the responses of tourists and residents alike; the availability of escape routes and warning lead time. These findings give credence to the hypothesis that the length of time before a disaster that a warning is issued, has 'considerable influence' in how messages are received and whether protective action is taken (p:521). Using as a case study a series of 'earthquake-near' predictions in 1976 of a 'great and destructive' earthquake in Los Angeles County, Ralph Turner (1983) explored several hypotheses about waiting for a disaster. One of them was that a false-alarm or a 'cry wolf' effect could result in people concluding that 'the entire alarm was unjustified in the first place' and that the forecasters or scientists 'did not know what they were doing' (p:308). But this paper argues that this definition is flawed and that the cry wolf effect is not a faulty premise at the *beginning* of a process but the *end* result of a series

of warnings. In dismissing 'cry wolf' as a possibility but then linking his conclusion with the credibility of experts, Turner ignores the vast body of risk communication literature that has shown there is a strong correlation between trust and credibility of officials on one hand, and the public's uptake and belief of risk messages on the other.

Findings from these case studies revealed two additional differences between reactions to SLT as opposed to LLT disasters; the level of urgency and imminence of the threat. Often the perceived likelihood of the threat in SLT disasters is high, as is the perceived level of danger, leading to higher vigilance and heeding of warnings. But if a LLT threat has been 'anticipated by numerous antecedent warnings' (Janis 1962:81), then by the time a final and more urgent warning is given, the potential hazard is perceived to be less of a threat.

The Literature – what is 'known' to date

Most of the literature exploring the 'cry wolf' phenomenon was published over 30 years ago and only two research-based studies of warning fatigue have been done to date. The first empirical study which found a 'clear and reliable False Alarm Effect' was devised in the late 1970's by Shlomo Breznitz, who felt that 'warning fatigue was too complicated a phenomenon to be studied in its natural environment' (p.23). To this end his research was lab-based and measured a fear reaction resulting from a known, contrived threat stimulus (an electric shock). Additionally, when testing for warning fatigue, Breznitz did not take the media and social context into consideration, something that both Barnes et al (2007) and Nigg (1995) suggest is important.

In the second study Atwood and Major (1996) used a prediction by a self-taught Mexican climatologist called Iben Browning; this paper was fraught with methodological limitations. However, it was useful in that it highlighted the need to examine the language used in warning scenarios, as terminologies were used interchangeably with no distinction made between 'warnings' or 'predictions', 'false alarms' or 'near misses', symbolizing the vague and contradictory nature of the literature. This is relevant because 'cry wolf' or warning fatigue is hypothesized as a phenomenon that results from being 'over-warned', not 'over-predicted'.

Much of the existing literature talks about the myth of the 'cry wolf' syndrome or effect, implying that it does not exist, however much of the same literature raises questions about the public's response and puzzlement as to their non-response. Sorenson (1993) calls 'cry wolf' a myth, yet when he explains what he means, he says that warnings 'are not *always* diminished by 'cry wolf' syndrome implying therefore that sometimes they are. As Joanne Nigg (1995) points out, a myth does not necessarily mean that a social phenomenon should be regarded as fiction, rather 'as a cultural explanation for events and phenomena that impact peoples lives' (p.374). Moreover, these myths are more likely to be associated with natural disasters (extreme weather, earthquakes, bushfires) than man-made technological ones (radioactive leaks, health scares) (Fischer and Bischoff 1998 cited in Nigg 1995).

The existing literature 'talks around' the issue of warning fatigue, for example, whilst Reser (1996) says there is little evidence to support warning fatigue, in the same paper he states 'repeated natural disaster warnings, as for example in the case of cyclones, can lead to inattention, complacency and desensitisation' (p.204). Sandman (2011) maintains that

people stop taking warnings seriously if previous warnings do not eventuate and there are too many warnings about risks that do not materialize, resulting in people who 'shrug off' future warnings. In his earlier literature Sandman does not consider warning fatigue to be a problem however, stating that its effect is weak and that people 'intuitively understand' that a false alarm is a much smaller problem than a disaster they weren't warned about' (2008). He adds that warnings, such as those issued for weather events, are 'calibrated' to be conservative and that the public instinctively know this, in much the same way that smoke alarms in houses are programmed to be oversensitive. However, in an article about flu pandemics three years later, he thinks warning fatigue is a huge problem; because of these 'false alarms' the public will react with considerable scepticism should another pandemic be declared. Sandman's article implies a warning fatigue reality (that it has an effect and can be overcome) without addressing some fundamental issues: those of cause, composition, consequences and solution.

The literature talks about puzzling reactions to warnings and hindrances to appropriate responses; the following sections 'False Alarms' and 'Experience' suggest that these are important issues to consider when trying to understand what constructs contribute to, or comprise, warning fatigue. The final section 'Implications' presents a hypothesis of further warning fatigue constructs.

False Alarms

The difference between a false alarm and a near miss needs to be examined as they may be different things to different people: scientists have vast amounts of data with which to predict and warn, however, the public may not be able to distinguish between a false alarm and a near miss, or credit a near miss as a false alarm and vice-versa. A paper by Simmons and Sutter (2009) that explored the false-alarm effect by plotting the level of tornado false alarms in the United States from 1986 to 2004 and comparing the death and injury rate, found that there was a statistically significant false alarm effect in areas with a higher false alarm ratio.

As Reser (1996) points out, the very idea of a false alarm is problematic as it implies that any response to the warning was a waste of time, maybe a bit foolish, certainly unnecessary. In terms of adaptive evolution, an alarm response to a life-threatening event is functional and productive. Warning fatigue therefore could be regarded as a maladaptive response to a hazard warning and Reser argues that the problem is that people are exposed to repeated warning messages in the absence of an actual event (p:204).

The difference between one false and several false alarms has been also highlighted by Dow and Cutter (1998, 2000), who argue that if the public understands why a false alarm has happened, their subsequent response to another alarm will not decrease. Additionally, they think that repeated false alarms may have an effect on not only response but on decisions to act (cited in Rhatigan et al, 2004:7).

Experience

In his book 'Cry Wolf: the psychology of false alarms' Brezntiz (1984) claims that 'a subsequent episode is automatically altered by past experience' (p:16). For example, if someone has experience of a disaster, are they more likely to be aware of its consequences and pay more attention to subsequent disaster warnings? Or will they be more complacent,

pay less attention to warnings and prepare less? According to Moore and Moore (1996) 'people with prior experience of a natural disaster are likely to experience heightened stress and anxiety when warned about a subsequent event, as a result of remembering and re-experiencing the past events' (cited in Reser 1996:207). The way that people reacted would of course depend on the outcome of their experience. For example, studies by Mileti and O'Brien (1992) suggest that a normalisation bias is evident for people who have had no experience or damage or loss in a previous disaster. 'Even in the face of warning information these people are less likely to personalize risk and respond to pre-impact warnings' (p:53). Drabek (2010) observes that experience has a 'curious effect on peoples risk perceptions' (p.207) and in relation to flood risk, if their immediate area has not flooded in their lifetime, then people take that as evidence that it will not flood in the future. Furthermore, the likelihood of a 100 year flood is dismissed because people just don't understand basic probability theory – 'gamblers fallacy'⁴⁵ is another way to understand this where people ignore the fact that random events are equally probable.

Implications

The existing literature dismisses the possibility of warning fatigue, yet paradoxically, state that people respond to warnings with apathy, become desensitised, complacent, sceptical, react less and prepare less if there have been alot of warnings. Moreover, no answers to these puzzling reactions are given. The literature is limited, dated and highlights issues that could contribute to the phenomenon of warning fatigue.

Arising from the literature, several warning fatigue constructs have been hypothesised; the table below presents these and the research questions that will be used to examine them.

⁴⁵ Gamblers Fallacy – The erroneous belief that if an event (slot machine pay-out for example) hasn't happened for a while, there is a higher likelihood of it happening as time goes on. The reverse fallacy is also true; where something has happened recently (50 year flood for example) leading to a belief that it won't happen again for a while.

**Warning Fatigue
Constructs**

Research Questions

Long lead time disasters	Are warning responses different if people have been living with the risk threat for months and years?
Experience	Does experience include severity, familiarity and consequences of past events?
Trust and credibility	Has people's experience of disaster warnings been mediated by television, radio and newspaper?
Media	Do theories of audience reception, issue attention cycle, 3rd person effect and framing explain how people interpret the news and 'what they do with it'?
Risk	How is the idea of risk understood and to what degree does uncertainty influence how people pay attention to warnings?
Social and cultural considerations	How have bushfires in Australia been understood and talked about?
Cognitive biases	How do personality traits of optimism, anxiety, responses such as 'anticipatory stress', theories of attribution and adaptations of normalisation and desensitisation contribute to warning fatigue?

An important and additional research question is: Do all of these constructs need to be present in order for warning fatigue to result?

This paper suggests that the two disaster scenarios of short and long lead time need to be acknowledged and differentiated, and that when examining peoples warning responses these differing types of disaster scenarios be taken into consideration. This will enable a re-

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conceptualisation of disaster warnings and will further an understanding of the conundrum that is warning fatigue.

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