WHAKARATONGA IWI

FIRE EMERGENCY NEW ZEALAND

CHANGING PUBLIC BEHAVIOUR: ENHANCED & IMPROVED COMMUNICATION OF FIRE DANGER

SCION

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This research explored the role of fire danger rating systems in communicating fire risk and how they relate to behaviour change. Behaviour change is complex and successful interventions are those that address multiple factors, as well as being flexible to different audience needs and contexts. The report offers recommendations as to how behavioural change approaches can be used to support the design of communication methods.

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Changing public behaviour: Enhanced and improved communication of fire danger and fire season status
Final Report

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Photo credit: Roadside billboard Wellington 2010, unknown.

Report information sheet

Report title	*CHANGING PUBLIC BEHAVIOUR: ENHANCED AND IMPROVED COMMUNICATION OF FIRE DANGER AND FIRE SEASON STATUS. FINAL REPORT.*
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Executive Summary

Introduction
Fire danger rating systems are a vital tool for fire managers in alerting the public and guiding appropriate behavioural responses. They form part of a suite of methods for communication of wildfire risk, including awareness raising through national campaigns, radio and newspaper reporting, community engagement and education programmes targeted at specific audiences.

Attention needs to be given to the most effective methods of communicating rural fire danger and fire season status to the general public in different contexts, which could contribute to a more strategic approach to communicating fire danger. There is a need to coordinate between various aspects of communication and understand not just how they are perceived by the public, but how they shape public behaviours in relation to rural fire risk.

Of broader concern is that community programmes based on information distribution alone have been found to be unlikely to lead to a measurable change in people's behaviours. Translating rural fire risk awareness to perceptible behaviour change requires an understanding of what works to encourage people to adopt appropriate habits for preventing fire escapes and adjusting their lifestyles to mitigate fire risks.

Background
Land managers have expressed concerns about the effectiveness of current rural fire danger warnings and how well they collate with guidance on fire season status. Earlier research found that most people were aware of fire danger warning signs; however they had limited understanding of what behaviour was expected of them or of fire permit requirements and how that related to fire danger warning signs (Langer & Hart, 2014).

Rural Fire Authorities and communities are particularly concerned about visitors' lack of knowledge of fire regulations and fire danger. Furthermore, while most landowners who use fire as a land management tool are aware of fire seasons and will often actively seek out information on fire season status, escaped land clearing burns and farm and forest machinery remain some of the largest known causes of wildfires (Doherty, Anderson & Pearce, 2008). While records suggest that these causes have reduced slightly over the last ten years, there has been an increase in the proportion of wildfires attributed to camp fires, bonfires and rubbish fires as known causes of wildfire (National Rural Fire Authority [NRFA], 2015).

Literature review
Studies of behavioural change, including a better understanding of why people behave the way they do, can be used to develop low cost approaches that tangibly shift members of the public into new ways of acting using alignment to natural modes of human cognition and thought processes (Cross, 2013). Furthermore, the impact of existing rural fire risk communication tools (such as fire danger signs and fire season status) can be greatly enhanced by appreciating experimental results of how behaviour is influenced by different communication efforts.

This research has been informed by several studies in New Zealand and internationally that recognise the importance of understanding behaviour change in relation to risk communication, including studies of social norms, self-efficacy and cognitive bias. Behaviour change is complex and successful interventions are those that can address multiple factors, as well as being flexible to different audience needs and contexts (Central Office of Information [COI], 2009).

Practical applications
Practical evidence is provided offering recommendations on how different behavioural responses can be used to design communication efforts which are more likely to achieve desired outcomes. This report provides a basis for thinking about how audiences respond to different communication methods rather than sending out a message in the hope that it will be received appropriately. The behavioural models underpinning suggested methods of communication are illustrated through living examples of behaviour change applied in a New Zealand context and internationally (Appendix A). Further discussion of behaviour change opportunities for New Zealand is presented following interviews with Principal Rural Fire Officers (PRFOs) capturing experiences that have led to both constructive and less constructive examples of how communication methods influence behaviours.

Some of the illustrations offered during interviews indicate that efforts are being made to guide public behaviours towards seeking permits in different regions. However, the conditions across regions vary and approaches to obtaining compliance with fire permit requirements also vary. Some argue that the regulatory environment involving penalties creates an unsustainable level of compliance costs on the fire authority. Nevertheless having hard instruments like legislation requiring fire permits during a high fire danger season and fire bans, when appropriate, provide a strong incentive for compliance. Concern about mixed messages of fire danger rating with regular variations and fire season status over a longer period of time however sends out a confused message, especially for those unfamiliar with local fire management practices and permit requirements. Clarification around what the message is and what behaviours are sought is needed. Once such a decision is made, greater effort can be directed to creating a national authority and branding recognition, as well as indicating what actions need and could be taken to mitigate fire danger.

Recommendations

Rural fire danger rating and fire season status signs are best seen as a trigger set within a wider set of communication efforts involving members of the public, fire managers, communication specialists, community educators, fire researchers and agency staff. Warning signs could form part of a more comprehensive strategy for increasing the capacity of communities to respond to fire danger. Understanding behavioural responses to warning signs and what drives them is important to enable changed approaches which work more meaningfully towards developing safe fire risk practices. Communication efforts will be more effective if they can better match messages to audiences' needs and motivations. However, awareness of how to shift behavioural patterns using a suite of communication tools and how to better target the activities of people to enable triggers that can reshape practices is necessary if communications are to be effective in changing behaviour.

This study goes part way to addressing some of the concerns of fire managers in developing appropriate messages and methods for changing behaviour. It makes the following key recommendations:

- Decide what behaviours are expected under different fire danger ratings and create a clear and consistent set of guides to support the realisation of those behaviours;
- Introduce property risk assessments as a relatively low cost measure to inspect properties and identify hazards that could be readily modified by property owners, increasing their self-efficacy;
- Respond to risk windows as windows of opportunity, e.g., after a fire event engage with exposed communities and build on the salience of the event to support individuals taking actions to change behaviour;
- Recognise the value of the threat of cost recovery liability (under the previous Forest and Rural Fire Act 1977) and permit requirements as hard instruments to enforce legislation and gain compliance rather than costly measures for catching culprits;
- Explore the role of fire-safe individual actions and neighbourhoods in reducing insurance costs to address the perception that higher fire risk areas, such as the rural-urban interface (RUI), may reduce property values;
- Work with community groups including local fire force volunteers, other group chairpersons or community fire wardens to support the development of appropriate social norms around safe fire behaviour led by community champions;
- Develop opportunities for using social media with those who have experiences on appropriate behaviours to spread the word through people in the community, e.g., fire force volunteers, on actions that can be taken as well as other pertinent information during fire danger periods;
- Target visitors via appropriate websites, freedom-camper and rental car companies to outline rules and regulations of fire permitting and compliance requirements as well as where to get further information; and
- Explore the use of symbols as a universal language to convey a clear and simple message about fire permit requirements and fire danger similar to the total fire ban symbol of a fire within a red circle with a diagonal line through it, e.g., for national use including TV fire weather reports.

Behaviour change takes time and requires prolonged and multi-pronged efforts to support the transition towards a more responsible and responsive public in fire risk management and safe behaviour. Face to face efforts are considered important for improving the development of appropriate social norms and recognising the limitations of current behaviours. Attention to messages that trigger desired behaviours rather than reinforce inappropriate social norms is important, and how the message is framed matters. Finding appropriate conduits for reaching diverse audiences also plays a role in supporting individuals' recognition that they are a target audience. Moreover, constructive processes of interaction in which people

are engaging in their own planning efforts can facilitate a level of local awareness that leads to greater preparation and capacity for community recovery.

Strategic opportunities

Methods of national branding and creating authority behind signs and symbols used across New Zealand clearly remain important for raising awareness. Legislated means of enforcing fire permit requirements are a useful hard instrument to leverage compliant behaviours. Attention to the needs of visitors and new residents of New Zealand, as well as people travelling between districts, is also important to direct people to the appropriate authority and fire risk mitigation rules and responsibilities. Appreciating the different environmental conditions in which fire risk changes along with needs for mitigation are also relevant aspects of effectively engaging members of the public in regional variations of fire danger messaging. Taking advantage of the windows of opportunity for people when their risk alertness is likely to be high, such as after major fire events or when a property is purchased, is also an effective means of altering behaviours in relation to rural fire danger. Finally better integration and use of communication technologies, as well as clearly defining what behaviours are desired of members of the public in relation to fire danger, are needed. The present stage in the history of New Zealand fire services with transition to a joint urban and rural fire agency (Fire and Emergency New Zealand) provides a pertinent opportunity to build upon existing knowledge of what works and to create clear lines of responsibility, that can be easily recognised by New Zealand residents and visitors, for adopting fire safe practices.

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Table of contents

1.0 Introduction

The Scion Rural Fire Research group has been funded by the New Zealand Fire Service Commission (NZFSC) Contestable Research Fund (CRF) to further research on the communication of fire danger warnings, with an emphasis on signs as one of the principle means for communicating rural fire danger[1]. A focus on appropriate messaging has been a key concern of the NZFSC to anchor its approach to communicating fire risk[2]. Concentrating on understanding the role of communicating risk in changing behaviour, with a focus upon both fire danger warning signs and other forms of rural fire risk communication, has been recognised as needed by both the NZFSC and Scion researchers. A research study approach has been agreed to with the Commission to further this knowledge and formulate appropriate recommendations for uptake by the NZFSC and subsequently the new Fire and Emergency New Zealand (FENZ) organisation.

Over the previous couple of decades, there have been higher levels of wildfire risk and more extreme wildfire experiences worldwide, leading to renewed focus on practices of fire risk reduction and fuel management in forested and urban environments (Paveglio, Boyd & Carroll, 2012; Smith, Kolden, Paveglio et al., 2016; Jakes, Kelly & Langer, 2010). Moreover, there has also been a growing rate of urban migration toward wildlands or bushland in the United States (US) and Australia including: changes in land ownership density at the urban fringe (Hammer, Stewart & Radeloff, 2009); and land management practices with greater amenity and landscape values often associated with the new occupancy (Reid & Beilin, 2015). With the growing severity of wildfires in other parts of the world, there has been a desire to have fire danger communication 'audiences' become more proactive and take greater personal responsibility for both living in/visiting areas of high fire danger and in the use of fire or equipment posing a fire risk (Healthy Forest Restoration Act [HFRA], 2003; Mockrin, Stewart, Radeloff et al., 2015). Subsequently, audiences are not just seen as passive recipients of authorities' information, but active in changing something they do (whether it is planning for risk, altering the hazards in their environment, or being more cautious in their use of fire) (Paveglio, Boyd & Carroll, 2012; Emergency Management Victoria [EMV], 2014; Mockrin, Stewart, Radeloff et al., 2015).

A range of methods and approaches have been developed and used internationally to better equip people with knowledge they can use to help protect themselves against fire danger (Paveglio, Boyd & Carol, 2012; Abrams, Nielsen-Pincus, Paveglio et al., 2016; Knopp, 2009), particularly in relation to homeowners in the rural- or wildland-urban interface (RUI or WUI) (Tibbits & Whitakker, 2007; Mockrin, Stewart, Radeloff et al., 2015). Attention has also been given to the adequacy of roadside fire danger signs in Australia, where a national review of traditional danger ratings have been measured against changes in wildfire conditions following the devastating Victorian Black Saturday fires in 2009 (Maddock, 2013; see also McLennan & Handmer, 2012; De Groot, Wotton & Flannigan, 2014).

While rural fire danger rating systems are a vital tool for fire managers and have been the subject of intensive research and development (Taylor & Alexander, 2006), less attention has been devoted to the most effective methods of communicating fire danger and fire season status[3] to the general public. However, for decades this has been recognised as a key component of fire danger rating systems (Dawson, 1991; Taylor & Alexander, 2006; Paton, 2006).

Previous research conducted by the Scion Rural Fire Research Group has established that the present system of New Zealand fire danger warnings could be improved. In 2009, Scion found that fire and land managers had reservations about the effectiveness of current fire danger warnings and considered that danger warning sign ratings did not collate well with guidance on fire season status (Langer, Tappin & Hide, 2009; Langer, Hide & Pearce, 2011). Scion conducted a public survey which revealed that: while most people are aware of fire danger warning signs and other communications, they frequently do not understand

[1] Fire danger is defined as "an assessment of both the fixed (e.g. fuels) and variable (i.e. weather) factors of the fire environment that determine the ease of ignition, rate of spread, difficulty of control, and fire impact" (Merrill & Alexander, 1987). Fire danger rating refers to the process of systematically evaluating and integrating the effects of these factors and representing them in the form of fire danger indexes (NRFA, 1998).

[2] Fire risk is the probability or chance of fire starting determined by the presence of activities of causative agents (i.e. potential number of ignition sources).

[3] Fire season refers to "the period of the year during which fires are likely to occur, spread and do sufficient damage to warrant organised fire control" (NRFA, 1998). A key component of rural fire management therefore includes declaration of the fire season status (as either an Open, Restricted or Prohibited fire season) as a means of controlling the lighting of fires through permits or fire bans.

what the fire danger ratings mean or what behaviour is expected of them; that the public have limited understanding of fire permit requirements; and that the permit system was rarely associated with fire danger warning sign communications (Hide, Tappin, Langer et al., 2010).

Hide, Tappin & Langer (2011) found an inadequate level of trust in the principle means of conveying fire danger information through roadside signs (half-grapefruit with fire danger ratings), with concerns about the reliability of the rating levels shown on the signs, as well as uncertainty from some audiences about who the message is aimed at. Following more recent research focused on effective communication of broader wildfire risk messages, Langer and Hart (2014) confirmed earlier studies (also identified by Bones, Pearce & Langer, 2007; Hide, Tappin, Langer, et al., 2010) and concluded that the roadside fire danger sign inadequately conveys risk information to result in appropriate behavioural responses where people understand what the sign means for their own actions/activities.

This Scion study also came to the conclusion that information on fire danger alone is not guiding the public towards desirable fire prevention behaviour (Hide, Tappin & Langer, 2011). The fire season information is a form of behavioural guidance, but was found to be confusing to some of the general public. Relatively few interviewees in the Scion study were found to follow existing publicity on the need to have a fire permit which was supplied in various forms identifying the need to provide accurate, up-to-date information on fire season status and focus regional signage at high risk locations. However, the primary reason for this low response is likely to be largely that the majority were not fire users (only 10% had been involved in a controlled fire, such as burning off or burning rubbish). The fire season information is an existing and known form of public guidance and, whilst its limitations are acknowledged, it has the potential to be developed in conjunction with other communication methods to provide the necessary information via a number of consistent message sequences, such as that offered by potential phone app alerts, webpage information or fire weather forecasts.

Fire risk communication literature (see Paton, 2006; Morrow, 2009) emphasises the importance of targeting separate messages to specific stakeholders. This same finding was highlighted in research carried out by Scion social scientists in 2012-14 (Langer & Hart, 2014). Communication strategies in three rural or rural-urban interface communities were analysed, and the research concluded that fire risk communication needs to carefully target both the audience (fire and non-fire using landowners, visitors and other residents) and the message (awareness, restriction/permitting information, fire prevention and preparedness) (Langer & Hart, 2014). The study found that both Rural Fire Authorities and communities were particularly concerned about visitors' lack of knowledge of fire regulations and fire danger. However, although most landowners who use fire are aware of fire seasons, and will often actively seek out information on current fire season status, the fact remains that they were found to be responsible for the largest number and area of wildfires with a known cause in 2008 (Doherty, Anderson & Pearce, 2008). In 2014 escapes from of campfires, bonfires and incinerator fires were also adding to the increase of human-caused fires (NRFA, 2015).

As previously stated, community programmes based on information distribution alone have been found to be unlikely to lead to a measurable change in public behaviours. Communicating fire risk awareness to the public is nothing new for fire authorities. However, translating this to perceptible fire prevention behaviours will only be successful if the public can be persuaded to adapt their lifestyles and their existing habits to some extent. We need to look beyond to explore why people make certain decisions and take specific actions. It is not enough to simply be aware of the potential consequences and risks of our behaviours (Wegwarth, Kurzenhäuser-Carstens & Gigerenzer, 2014). Most smokers are likely to be aware that smoking is unhealthy, yet they still engage in this behaviour. Why? Understanding the 'why?' is a fundamental step in progressing from a merely educational initiative to a meaningful behavioural shift.

By drawing on the most recent academic evidence, cognitive psychology and behavioural change, psychology tools can be applied to develop low-cost approaches that can tangibly shift the public into new ways of acting using alignment to the human brain's natural mode of thinking (Cross, 2013). There is a belief that if we provide people with accurate information and incentives, they will weigh up the risk/benefit ratio and respond accordingly. Recent research has shown that this expectation is flawed as people do not always respond logically (Peters, Klein, Kaufman et al., 2013). Therefore, shaping the fire prevention communication initiative more closely around the psychology of people's inbuilt responses allows for adaptation to changing contexts, backgrounds and environments. Furthermore, the impact of existing fire risk communication tools (such as fire danger signs and fire season status) can be greatly enhanced by new evidence about how human behaviour is influenced.

Signs are a tool amidst a suite of communication efforts that are used to guide people's behavioural responses to fire danger conditions. Both one-way (such as pamphlets, radio and TV broadcasts and some

educational tools) and two-way (for example, face-to-face engagements, Q&A sessions and participatory risk assessments) approaches are useful for different contexts of communicating fire danger. There are multiple means and methods of communicating fire danger that can be drawn into a more strategic approach to help shape and plan effective fire danger communications. We already have an appreciation that different audiences with different fire risk exposures and awareness will require different methods of communication (Langer & Hart, 2014). An opportunity exists to think about the effects of different messages and how they can be brought together to achieve a consistent overarching message whilst targeting various groups and individuals more appropriately.

The research undertaken for the New Zealand Fire Service Commission (NZFSC) and documented in this report involves active engagement with rural fire officers and communication staff to enable the National Rural Fire Authority to develop effective methods of communicating rural fire danger specifically. However, it also draws on international experiences to introduce any new areas of thinking about changing behaviours in relation to rural fire risk issues more generally. Its objectives are to understand effective means of communicating fire danger, fire season status and fire risk information that will lead to a change in public behaviours as needed to reduce the likelihood and consequences of wildfires. The aim of the research is to lay the foundation of understanding communication to change public behaviours for rural fire officers in their task of engaging members of the public to be more empowered and to see themselves as a key stakeholder in fire prevention and fire risk mitigation.

2.0 Background to Behaviour Change

A report by the British Central Office of Information (COI, 2009) noted that human behaviour arises from diverse psychological factors, including those shaped by social interactions, wider societal conditions and contextual influences such as the resources at hand and environments in which activities are undertaken. Human behaviour is complex and changing behaviour is challenging. Successful interventions are those that can address many factors at once and are flexible to different audiences and contexts (COI, 2009; McCaffrey, 2015; Christianson, McGee & Jardine, 2011).

Lasting behaviour change related to rural fire danger requires a process of sustained engagement where audience groups need to become partners in the process of communication (Christianson, McGee & Jardine, 2011). Rather than passive recipients of information, audiences need to be considered as actors with meaningful contributions to communication efforts (McCaffrey, 2015). From the perspective of behaviour change, messages are best seen as operating in a system of activities where they can be better designed to work with the intuitive actions of people in the system and developed to reduce or manage fire danger. At the same time there is a need to appreciate that behavioural models are approximations of reality and work best when applied in the contexts they were developed. Building greater flexibility into models does not necessarily lead to achievement of desired results. Models need to be considered carefully in relation to the problem at hand and how they can be used to guide interpretation and meaningful engagement with those in whom a change in behaviour is sought. Behavioural models are best seen as tools “in the process of developing intervention with the audience groups in question” (COI, 2009).

By embedding our inquiry into communicating fire danger in a bigger picture of behaviour change we can start to think of individual communication efforts as contributing to a broader view of community engagement in fire risk reduction. A review of the international literature on communication methods and behaviour change conducted for this study has been tailored toward supporting more strategic thinking in relation to wildfire danger and building on existing mechanisms used for communicating fire danger information and fire season status.

The behaviour change (see section 5.1) component of the literature review considered approaches that are best suited to modify behaviours and possibly introduce new behaviours. Combining communication methods with the behaviour change review paid attention to the effects of different communication methods and different kinds of messages and messaging that could increase the impact of effective behaviour change.

3.0 Project Aims and Objectives

The project aims to build on current understanding of communication methods to design approaches that inform practical initiatives for creating measurable behaviour change. It uses the following four objectives to support the delivery of outcomes relevant for New Zealand fire authorities:

- Increase the understanding of international and national communication methods for rural fire and other natural hazards, and behaviour change initiatives, to meet New Zealand-specific national and regional **fire prevention needs**.
- Explore innovative approaches to communicating fire danger and fire season status and **evaluate the potential** of these approaches to bring about real behaviour change amongst the community profile groups.
- Use **key stakeholder feedback** on the practicability of selected initiatives for New Zealand rural, semi-rural and recreational fire users to derive initiatives for implementation at national and regional levels.
- **Create measurable impact** for New Zealand fire authorities by informing realistic and innovative initiatives that will lead to meaningful behavioural changes and that can be put into practice rather than simply suggesting a theoretical or higher level approach.

4.0 Methodology

This research has followed a multi-methods approach to analyse communication methods and behaviour change. It has looked at international as well as local research and initiatives from fire and non-fire contexts to reflect on what has been effective and how useful that may be for a New Zealand rural fire context. Scion's previous literature reviews have been updated to examine international communication methods, and innovative behavioural change approaches for rural fire and other natural hazards. The following steps were taken to build on existing Scion research to determine contextually applicable approaches and tools for national, regional and local contexts within New Zealand.

- Web-based review of behavioural change campaigns used in New Zealand and internationally, including social marketing, was conducted to explore the scope of practice and innovations that could be applied or adapted to a New Zealand context of fire danger.
- Postings were sent to international fire-related networks through groups in LinkedIn seeking input on practical risk communication and behavioural change methods that have been tested internationally.
- Emails were sent to fire researchers/practitioners in international wildfire agencies and research networks asking for information on successful fire danger communication initiatives, along with comments on critical factors contributing to behaviour change.
- Semi-structured telephone interviews were conducted with five key fire managers in New Zealand communities and five international fire researchers/practitioners to ascertain key influences and factors contributing to the success of initiatives leading to marked change in public behaviours.

Comprehensive review

A review of the international literature on fire danger and other risk communication methods was conducted, including grey literature of programmes and examples of efforts directed at changing behaviours. Current understanding of behavioural models and theories of change were incorporated into a draft literature review report. Analysis of communication methods and behaviour change were combined to provide a 'toolkit' comprising a set of examples that illustrate how behaviour change theories had been applied in other contexts and could be applied in a fire danger communication context in New Zealand (Appendix A).

Network surveys

Leading fire researchers at Scion were approached to recommend people to contact from international research networks. Networks were contacted in Australia, Canada and the US via email to survey their experiences with communication methods that led to effective behaviour change, and what measures of success they were using/might use to evaluate effective methods.

People who responded to the request for information provided links to other possibly useful contacts, as well as examples of communication methods seen as effective in changing behaviour. Examples were collated into a database of effective communication methods, including some initial measures of success, to consider for further development.

Crowdsourcing

While efforts to survey respondents through crowdsourcing was less successful than anticipated, a valid list of potential interviewees with credible fire danger communication knowledge and behaviour change experience was generated. Some examples of innovative approaches and communication methods were gathered to include in the database. A small set of potential participants was identified for interviews.

Online interviews

Selected interviewees were sourced from the pool of New Zealand's Principal Rural Fire Officers (PRFOs) as well as international networks linked to Scion colleagues and contacts made through crowdsourcing. Four questions (Appendix B) were sent to interviewees prior to conducting interviews using the online meeting platform Zoom, addressing observations of and experience with methods of communicating fire danger that have resulted in effective behaviour change.

Ethics

All participants were advised of the purpose of the research and methods being followed. They were advised that their responses would be documented through note taking. Participants were also advised that they would not be personally identified unless specifically requested. An explanation of the research was provided by email and agreement to participate in the research indicated that consent was given.

New Zealand participants were advised that the preliminary findings would be shared during a meeting with key stakeholders for feedback to contribute the analysis of the findings. International participants were advised that a copy of the data collected on communication methods and measures of success in changing behaviour would be provided to participants at the conclusion of the study.

5.0 Literature Review

A milestone report (Grant, Hooper & Langer, 2016) documenting international and national communication methods for rural fire hazards, and behaviour changes initiatives, has been presented to the NZFSC. The report builds on existing understanding and current practice in communicating fire danger and behaviour change to present an appreciation of international developments and a set of practical tools that could be applied to a variety of communicating fire danger contexts in New Zealand (Appendix A).

Summary of key findings on communication methods

A summary of findings is presented to indicate that a range of communication methods designed to achieve a set of objectives to increase capacity to prepare for and respond to wildfire danger are in use. The following methods were discussed in the milestone report:

- Public messaging or broadcast information;
- Education and awareness raising;
- Legislative requirements (mandatory and policy);
- Citizen groups and community action; and
- Social media including apps and networks.

However, not all approaches are embedded in an understanding of behavioural models or designed according to theories of behavioural change. Areas of behaviour change theory and their implications for achieving desired changes in behaviour are identified and discussed in the following section. Some common misunderstandings about behaviour based on research evidence are presented to better appreciate the effectiveness of communication methods and message choices.

Communication methods

Public messaging or broadcasting is an important means of raising awareness (Tibbits & Whittaker, 2007). However, raising awareness does not necessarily result in behaviour change (Langer & Hart, 2014). People are not always aware that messages are directed at them and information may lack specific direction on what people can do to reduce risk or vulnerability (Bones, Pearce & Langer, 2007; Hide, Tappin, Langer, et al., 2010; Hart & Langer, 2011; Langer & Hart, 2014; Erikson & Prior, 2013; Reid & Beilin, 2015).

Face-to-face interaction and personal involvement are useful devices to support decisions about risk and to help discuss local contextual factors that people experience when making decisions (Langer & Hart, 2014; McCaffrey, 2015; McLennan, Paton & Wright, 2015). They can play a role in educating people, but also in changing social norms or establishing new patterns of behaviour that are more responsive to risk (Reid & Beilin, 2015; Erikson & Prior, 2013; Verrucci, Perez-Fuentes, Rossetto, et al., 2016; Brenkert-Smith, Champ and Flores, 2012).

Policy directions can be oversimplified and fail to take into account the complexity of human decision making and action in relation to the dynamic environment of risk (Erikson & Prior, 2013; McLennan & Handmer, 2012; Handmer & O'Neill, 2016). Policies such as 'Leave and Live' or 'Stay and Defend' may prevent people from taking more considered action in relation to preparing themselves to take action, or to adapt decisions to the context as risk emerges into an actual threat (Maddock, 2013; see also McLennan & Handmer, 2012; De Groot, Wotton & Flannigan, 2014).

Furthermore, policies are not always followed, and people do not adopt best practices because of varying perceptions of their environments and the fire risks within them (Hammer, Stewart & Radeloff, 2009; Shindler, 2010). Critical decisions often need to be made well in advance of fire seasons (McLennan & Handmer, 2012; Handmer & O'Neill, 2016). However, community engagement can realise stronger community cohesion and empowerment to build capacity to act and increase local resilience to wildfires (Vogt, Winter & McCaffrey, 2010; Shindler, 2010). It can also contribute to the development of new localised social norms based on an appreciation of the risks within one's environment (Reid & Beilin, 2015; Shindler, Toman & McCaffrey, 2010; Dickinson, Brenkert-Smith, Champ, et al, 2015).

Where there is a sense of shared responsibility towards wildfire risk reduction, communities can view rules or ordinances with penalties positively (Paveglio, Boyd & Carol, 2012; Abrams, Nielsen-Pincus, Paveglio et al., 2016; Winter, McCaffrey & Vogt, 2009). They also use this as a means of bringing about greater accountability and compliance of neighbours or cooperation of agencies in supporting constructive actions (Vogt, Winter & McCaffrey, 2010; Wilson, 2016).

In the US, fire-adapted communities offer a network of learning for people exposed to wildfire risk and have been recognised as supporting the constructive development of community wildfire protection plans (Fulks, 2016; Wilson, 2016). They and other community engagement approaches follow more systemic approaches to building collaborative planning capability and community resilience to wildfire risk through facilitating the development of relationships between the community and fire authorities (McCaffrey, 2015; Paton, Frandsen & Middleton, 2013). People that have been involved more directly in planning efforts report benefits such as building trust and meaningful opportunities for involvement in management decisions (Shindler, Toman & McCaffrey, 2010; McDaniel, 2011; 2014).

A growing interest in social media and using mobile technologies that can provide site specific information on fire danger, such as local weather conditions or fire incidents, are increasing capability for making more appropriate fire risk decisions (Sutton, Palen & Shklovski, 2008; Taylor, Wells, Howell et al., 2012). Fire managers that have embraced such technologies have used them for listening to and guiding responses for those in affected communities (Latonero & Schlovski, 2011). Social media is also used to share lessons and experiences in handling the dynamics of fire risk through knowledge sharing networks between researchers, fire managers, agency staff and communities (Jakes, Carroll, Paveglio, et al., 2010; Latonero & Schlovski, 2011; Haworth, Bruce & Middleton, 2015; WLLC, n.d.)

Building on this appreciation that different communication methods achieve different levels of desired result, and that one-way and two-way communication methods can serve different functions (e.g., awareness raising versus changing something that people do) (COI, 2009; McCaffrey, 2015; Christianson, McGee & Jardine, 2011), a review of behaviour change theory and practice is now offered. Following this review findings are presented from interviews conducted with local fire managers, as well as international researchers and practitioners, with a discussion of relevant behavioural models that can be used to better inform communication methods and practice.

5.1 Behavioural Change in Theory and Practice

Creating real, lasting behaviour change is a challenge. If fire authorities are to produce effective interventions targeting fire danger awareness and fire season status, an understanding of the theories underpinning behavioural changes are needed (Dolan, Hallsworth, Halpern et al., 2010). Shaping fire communication initiatives more closely around neuropsychology and behavioural psychology principles will support adaptation to changing contexts and tangibly shift members of the public into new ways of acting. Behavioural economics (or the economy of behavioural choices) is one of the means of using short cuts in cognitive processes to create choice options where changing becomes easier or more palatable than the default option (Thaler & Sunstein, 2008).

While behavioural economics does not generate drivers for behavioural change, it does offer principles with which our behavioural change tools can be sense-checked and vetted in alignment with natural modes of thought and function. It is important to remember that although we may be designing behavioural change initiatives for different target audiences based on perception and awareness, we are all nonetheless bound to function within a common physiological capacity of the human brain. That is, despite our different ages, genders, intelligence, social class and personal preferences, our brains have evolved with inherent, innate cognitive structures subject to common biases and other psychological nuances (Ariely, 2008). From a behavioural change perspective, it is important to understand this way of reasoning to provide greater assurance that initiatives will function as expected.

Although not an exhaustive categorisation of available tools, this review provides a platform on which successful behaviour change interventions can be built by:

1. Exploring relevant theory and providing scientific evidence on the robustness of influence on our behaviour.
2. Demonstrating how behavioural change has been achieved in similar contexts using applied examples and case studies.
3. Condensing and integrating behavioural change theory into practical applications for suggested initiatives for the NZFSC.

Modelling behavioural change using systems thinking

Behavioural models are used to identify factors that have a significant influence in determining behaviour and demonstrate that change is a dynamic process as opposed to a single, discretionary event (Rogers, 1995; Prochaska & Velicer, 1997; Darnton, 2008). Building on this, systems thinking enables us as practitioners to analyse the interrelationships between influencing factors of a complex behaviour and anticipate the effects of potential initiatives. One of the principles of systems thinking is that the whole is more than the sum of the parts, and influencing or changing one individual, social and/or environmental factor will impact on the rest of the system. The incorporation of such thinking has been successfully utilised in changing behaviour interventions, including decreasing drunk driving (Angle, Pinkney, Johns et al., 2012), preventing AIDS transmission (Kegeles, Hays, & Coates, 1996), and improving the use of seat belts (Linkenbach & Perkins, 2003). For behavioural change interventions to be successful, we therefore suggest that they will need to be planned, collaborative and sustained over time.

Influencing behaviours

There are several aspects of social and cultural practice that influence or attempt to influence behaviours even though the natural mode of human thinking may override such efforts. Having an appreciation of the dynamics between societal expectations and human actions is important for understanding behaviour change. Influences range from hard instruments such as legislation and regulation that create penalty and law enforcement conditions, to information provision supporting the development of social and cultural norms. However, there are also aspects of human thinking including self-efficacy, or the belief that one can be effective in changing their behaviour or heuristics[4] and biases based on rules of thumb and short cuts to make decisions quickly that influence behaviour. These often compete with more rational approaches implied by rules and regulations or information provision**.**

Legislation and regulation are conventional policy instruments that compel us to behave in a particular way. A person's environment can also be both a powerful driver for behavioural change and an effective influence on behaviour. Environment has been considered to influence public behaviour at either the macro or the local level, such as the wider economic or technological conditions or the social and physical surroundings that constrain or enable actions (COI, 2009). In general terms, local and macro environmental factors over which an individual has limited control that influence behaviour are most often addressed by policy changes or service provision. Despite their effectiveness, hard policy instruments are often considered costly as they are characteristically resource-intensive in terms of policing, such as issuing permits or taking legal action when a regulation is breached.

In the context of fire danger, decades of research have shown that communication programmes based only on information distribution are unlikely to lead to a measurable change in public behaviours (Christianson, McGee & Jardine, 2014; Fairbrother, Mees & Tuer, et al., 2014). **Providing information** may not have the expected effect, or indeed any effect, on behaviour (Hart & Langer, 2011). Even where information portrays a sense of consequence for poor behavioural choices, it is not enough to merely be aware of the potential consequences and risks of behaviours (Curtis, Garbrah-Aidoo and Scott, 2007). Therefore, information for knowledge and awareness is commonly considered the first step in progressing from an educational initiative to a meaningful behavioural shift, rather than the only step.

'Rational Choice' is a socio-economic theory that assumes people will always make logical decisions and act to maximise personal benefit and minimise costs, given the choices available (Goode, 1997). However, decades of psychological research have shown that humans have two distinct means of processing information of which rational thinking is only one (Tversky & Kahneman, 1973, 1974; Kahneman & Tversky, 1972; Kahneman, 2011). Automatic/unconscious and controlled/conscious decision making are often translated into two separate reasoning systems, commonly described as dual process theory in psychology (Kahneman, 2011). Insights into this dual process have been gained from studies using animals, whereby the automatic system is shown as responsible for everyday functioning while the conscious system handles executive mental tasks in which complex information is handled more analytically (Graybiel, 2008). Over time, a repeated behaviour will become more and more habitual and this automaticity develops into a key driver for our day-to-day behaviours (Woods & Neal, 2007). This means an observed behavioural response may not be the result of a carefully reasoned choice based on information provided, it may just be a

[4] A heuristic is a device used for learning or decision making; it can be a model or an approach that simplifies the learning or decision context and is often referred to as a 'rule of thumb'. Although reliable in many cases, it is not empirically validated but acts more as a mental shortcut such as a trial and error device that yields useful results where time or knowledge resources are limited. It is what we commonly use to find approximate solutions when an exact solution is not available or possible.

conditioned habit based on frequency rather than conscious application of logic. Several behaviour change theories argue that **habitual behaviour** must be raised into the conscious mind to enable them to be changed (Lewin, 1951).

Many early behavioural psychology models postulated that attitudes lead to action (Fishbein & Ajzen, 1975). However, evidence now suggests that the influential link between attitudes and behaviour is not as robust as once thought, and that other factors may have a larger influence on behaviour. For example, **self-efficacy** is a person's belief that he or she has the capability to successfully perform a particular action to bring about an expected outcome (Bandura, 1997). In terms of behavioural change, lack of self-efficacy can be a barrier. Public response to climate change provides an illustration of how the lack of self-efficacy may effect behaviour – people feel the problem is too great to make a difference and therefore do not alter their actions in any way (Darnton, 2008). Behavioural change initiatives can amplify individuals' self-efficacy by making certain behaviours seem achievable, for example, by using testimonials of others who have changed their behaviour successfully, and clear instructions regarding the uptake of relevant skills (Darnton, 2008). Another example is the way in which emotions can act as a prompt for changing behaviours. Emotions can have a powerful and automatic effect on our behavioural responses. Our mood, such as fear or anxiety, can thus have a significant influence on decision making, often overriding logical reasoning (Curtis, Garbrah-Aidoo & Scott, 2007).

Research has provided strong evidence that we tend to underestimate the extent to which we are affected by other people's behaviour (Goldstein, Martin and Cialdini, 2007; Linkenbach & Perkins, 2003; Schultz, Nolan, Cialdini et al., 2007). **Social and cultural norms** are the customary 'rules' that define and govern acceptable behaviour within a society or group. When we are unsure of behavioural expectations in certain situations, we look to others to guide our actions. Social norms can be a powerful tool when inducing behavioural change, as a consequence of the associated social benefits of conformance or the social penalty for non-conformance. Behavioural change interventions can identify and highlight targeted social norms, prompting people to act in accordance with them (Goldstein, Martin & Cialdini, 2007). If a social norm is desirable, then initiatives should aim to increase awareness of it using approaches such as:

(1) peer-to-peer approaches through word of mouth, online forums and communities;
(2) testimonials from others who have adopted a behaviour; and
(3) respected opinion leaders as 'ambassadors' for a behaviour.

While social norms can be modified rapidly as the result of legislation, reinforcement over an extended period will likely be required for social norm effects to become self-sustaining.

It is important to be aware of the risk of inadvertently legitimising the behaviour intended for change by making it appear widespread and therefore an accepted social norm. For example, a campaign to reduce household energy by sending information on average usage rates found that while those using more than the average did reduce their consumption, those consuming less than the average increased their usage (Schultz, Nolan, Cialdini et al., 2007). The way that information is framed therefore can negatively influence the desired outcome.

Behavioural economics is the intersection of psychology and economics. The foundation of behavioural economics holds that decisions are context dependent and may be flawed due to natural biases and mental shortcuts (heuristics). While behavioural economics does not generate drivers for behavioural change, it does offer principles with which our behavioural change tools can be sense-checked and vetted in alignment with natural modes of thinking and functioning. Two such modes are **heuristics** and **cognitive biases**. Heuristics are efficient cognitive 'shortcuts' (Gigerenzer & Gaissmaier, 2011). Well-known heuristics that can potentially impact on behavioural change initiatives include the availability heuristic (how easily an event is recalled or imagined), the representative heuristics (decisions based on similarity), and anchoring heuristic (bias for default starting point). Cognitive biases are systematic involuntary mental processing shortcuts we use when time is limited or when we lack knowledge about a subject or situation (see Table 1).

Table 1. Well-known cognitive biases and their potential impact on behavioural change initiatives.

Biases	Description	Behavioural Change Impacts
Framing Biases	Choices are influenced by the way they are presented or framed. In particular, we are loss-averse. For example, a message framed as a loss – 'you will lose $X each year if you don't service your car' – will have more impact if it were framed as a gain – 'you will save $X each year if you have your car serviced'.	The context of delivery shapes a person's perceptions about the information. Framing information as positive can elicit good feelings, risk taking and proactivity. Framing information as negative may provoke bad feelings, risk aversion and reactivity.
Salience Biases	Information that is conspicuous, novel or seems appropriate is more likely to shape our actions.	Salience can be manipulated by rearranging or introducing factors into the physical environment.
Status Quo / Inertia Biases	Humans have a natural preference for the default option or status quo (inertia).	Give some thought to strategies for overcoming inertia, for example by making the behaviour seem easier to undertake than people perceive it to be, or by setting the default as something to opt out of rather than opt in to (Thaler & Sunstein, 2008).
Temporal Biases	We have a tendency to prefer short-term reward over long-term gain (COI, 2009). For example, people may not prioritise saving for retirement so that they have more money now. We are more likely to disregard future gain if it appears more remote – so, younger people are even less likely to prioritise investment into their retirement.	These biases may be overcome by assisting target audiences to connect with their future selves. One study showed participants an older avatar of themselves as a means of achieving this connection (Hershfield, Goldstein, Sharpe et al., 2011).

Choice architecture

When attempting to influence behaviour, it is imperative that the signal (or behaviour prompt) received is consistent with the desired action (Thaler & Sunstein, 2008). If there are inconsistencies, then performance of the behaviour will suffer. Doors can be designed to be consistent or inconsistent with the 'opening' action. Flat surfaces encourage door-openers to 'push', whereas handles say 'pull'. The signal is incompatible when the intuitive action does not match the action required to open the door (for example, the door has handles but requires people to push to open). This incompatibility results in slower response times and increased error rates. Essentially, the design of the doors has failed to accommodate the fundamental principles of human psychology (Thaler & Sunstein, 2008). We would describe such design as poor architecture. The design of behavioural choices is subject to similar architectural requirements – choice architecture ought to reflect a good understanding of how we behave.

There are several practical principles in our behaviour that we can incorporate into the choice architecture to increase the chances of the desired actions being readily adopted, including:

- Overcoming inertia;
- Expecting error;
- Providing feedback;
- Mapping behaviour;
- Structuring complexity; and
- Applying incentives.

The first is in alignment with the inertia bias – humans are most likely to take whatever option requires the least effort. This tendency can be circumvented by having a required or mandated choice on simple choice scenarios. In more complicated choice scenarios, most would appreciate a sensible default option already engaged. The second is that we should expect error. Humans are fallible beings, so we must ensure our interventions direct appropriate resources towards reducing the magnitude of these inevitable by-products of human functioning. For example, Google recognises and sends the user a reminder prompt ('nudge') if the word 'attachment' is mentioned in an email but there is no file attached to counteract the forgetfulness of busy workers and 'nudge' an appropriate response (Thaler & Sunstein, 2008). Thirdly, the provision of feedback will improve performance of a behaviour. This can be achieved prior to a behaviour (e.g., laptop battery low warning), during a behaviour (e.g., repainting a white ceiling with a pink-drying-to-white paint so no spots are missed), and/or after a behaviour (e.g., digital cameras and smart phones show the image

captured). The fourth principle is effective mapping (Thaler & Sunstein, 2008). Mapping is the understanding the person has of what they will experience should they engage in a particular behaviour. Good choice architecture improves the person's ability to map and thus select desired behaviours. An illustration of effective mapping is choosing to stay or go when confronted with an approaching wildfire – if you would like to stay and defend your property, further decisions must be made as the fire comes closer; questions of safely sheltering on or escaping from your property may depend on other conditions such as ability to survive if isolated for a period of time or having road access to evacuate. Structuring complex choices is the fifth practical principle. When faced with a small number of choices, people can make a choice based on their own preferences after reviewing each option. However, the comparison process is not as easy when there are lots of complex options. The principle of structuring complex ideas is all about reducing the opportunity to miss out on the best choice because of complexity. The final choice architecture principle that helps to increase the likelihood of behavioural uptake is based on incentives. People will always ask the question: 'What's in it for me?' Therefore we must think of sensible and applicable incentives when we are designing a behavioural change initiative.

Concluding comments on influencing behaviour

Internationally, the successful programmes that have brought about effective and sustainable changes in behaviour have used systems approaches integrating cultural, regulatory and individual change into a suite of practical measures. This is then combined with practical insights and instruments from psychology and behavioural economics that are embedded into the intervention processes which are in turn framed by theories of change. In this particular case study, signs are seen as a trigger for behaviours, but not the only mechanism needed for increasing the chances of people adopting appropriate behaviours. Social norms play an important role in facilitating desired behaviour, and 'nudge' approaches can be a powerful means of developing appropriate individual responses to fire danger. Behaviour change takes time, and requires prolonged and multi-pronged efforts to support the transition towards a more responsible and responsive public in risk management and safe behaviour.

6.0 Behaviour Change Experiences and Opportunities

Literature reviewed for this research has laid the foundation for identifying successful strategies and methods that can be applied to raise public awareness of rural fire risk and also be translated into desired behavioural actions. Such actions have been considered to be successful if they lead to a reduction in the potential number and/or consequences of unsafe fire ignitions. Behaviour change campaigns using traditional approaches such as TV advertising, pamphlets, and newspapers, whilst effective in raising awareness, are recognised as limited in actually changing something that people do. An appeal to people's personal values may be more effective than pitching messages to higher ideals such as nature conservation or fire safety. In this discussion we present some of the findings from our interviews with rural fire officers and international researchers and practitioners in an effort to align different communication methods with behavioural models and demonstrate how communication efforts may be used more effectively. We have presented these as vignettes, or small illustrations, to indicate specific communication opportunities. We conclude with a summary of relevant behavioural models and change initiatives for designing communication efforts more likely to achieve desired changes in behaviour.

We have also developed a 'toolkit' of suggested behavioural change approaches drawing on international and non-fire contexts that could inform the design of communication methods in a New Zealand rural fire danger context (Appendix A). The toolkit provides a basis for further discussing the perspectives of rural fire officers underlying a strategic approach to using systemic behavioural change initiatives. In this section, a potential framework for behavioural change is discussed that includes consideration of legislation, environment, risk windows and communication methods that contribute to a set of implementable recommendations. This knowledge and framework was shared with fire managers and research managers from Fire and Emergency New Zealand as a means for facilitating a conversation about desirable and feasible changes in current approaches to communicating fire danger.

Systemic behavioural change initiatives

Our review of the literature on communication methods and behaviour change acknowledged the need for prolonged and persistent effort to change long-term behaviours and cultural norms. However, it also noted the importance of using different methods suited to the context of an overall desired change in behaviour (Paveglio, Boyd & Carol, 2012; Abrams, Nielsen-Pincus, Paveglio et al., 2016; Reid & Beilin, 2015), as well as methods that were suited to different target audience knowledge needs (Tibbits & Whitakker, 2007; Mockrin, Stewart, Radeloff et al., 2015; Langer & Hart, 2014).

People need to know what is being asked of them and how they can take actions to support effective mitigation of fire danger and prevent the realisation of fire risk. An understanding of who or what might be the best conduit or channel to reach diverse audiences can help people to understand that they are a target audience (Vogt, Winter & McCaffrey, 2010; Christianson, McGee & Jardine, 2011). If efforts are required to change social or cultural norms towards appropriate behaviours then face-to-face interactions are important, and the framing of messages in a way best suited to audiences' practical and cultural perspectives needs attention (Erikson & Prior, 2013; Shindler, Toman & McCaffrey, 2010). People also benefit from constructive interactions in which they are supported by engaging in their own planning efforts to increase local-level awareness of fire hazards, and such approaches can lead to better preparation and recovery from wildfire events (Reid & Beilin, 2015; Dickinson, Brenkert-Smith, Champ and Flores, 2015; McNeill, Dunlop, Heath et al., 2013).

Box 1 Vignette: Increasing self-efficacy through low-cost risk assessments
From the Fire Adapted Communities (FAC, n.d.) interagency programme in the US, there is a recognition that people need to be engaged in their own planning and that no two communities are alike. Providing the support of risk assessors and utilising tools for enabling people to consider the hazards within their own home environment works. However it has been noted that this type of approach works best for those highly exposed or remotely located, where they have a will and ability to take actions that can reduce their vulnerability to fire danger. Nevertheless no effort should be rejected; all attempts to change behaviour have their place (C. Bath, personal communication, April 26, 2017), and having adequate resources to action decisions is important. Self-efficacy is best realised when people are aware of the risks and able take some simple steps to minimise their exposure. Furthermore a systemic view of the problem at hand that examines both the people and the setting of the problem can

result in relatively simple low cost solutions with flow on benefits. In this case not only were risk assessments reported to cost less than $1 but where people were motivated to take further steps, the cost of doing a full risk assessment (reported cost of about $30) through engagement with a fire hazard specialist paid off in other ways (C. Bath, personal communication, April 26, 2017). Having completed a full risk assessment, the property owner then became a potential champion to others in the community by taking their own simple actions to a wider audience and demonstrating how they could reduce their own risk such as at a community / street BBQ.

Systemic approaches to behaviour change can help to recognise that no single method is going to be effective, and that a multi-pronged and prolonged approach that can match efforts to effective methods is essential to success. An awareness that different approaches may work in different contexts and that combining approaches can be more effective than over-investing in one (e.g., TV advertising) is important. Such appreciation can be supported by evidence of what works where and why, as well as better understanding of how context influences the effectiveness of methods used, i.e., methods that are fit for purpose.

We discuss four main areas that contribute towards changing behaviour in different contexts, and in which we can link behavioural models to effective means of communicating fire danger. The first is legislative, or using hard instruments of ensuring appropriate behaviour such as penalties. The second is environments, and how they can be modified to change people's response to fire danger; and the third, risk windows or windows of opportunity, e.g., in which the salience of an event becomes a strong influence on people's behaviour. Finally we discuss communication and how appreciation of the effectiveness of communication in different contexts can help design appropriate means for the situation or where communication methods chosen are those that best reflect the circumstances in which a particular desired behaviour is being sought.

Legislation (Hard instruments of change)

The legal requirements for people lighting fires or working with equipment that might produce fires are hard instruments that can be the most effective means of changing behaviour, depending on the penalty relative to the proposed activity or action. However, they can be resource intensive to implement, monitor and enforce. Importantly, they may not necessarily be seen as effective from a behavioural model point of view. As noted in the behavioural literature review (Grant, Hooper & Langer, 2016), if the penalties are not sufficiently high to deter undesired actions or behaviours, they will not work. Parking fines are an example however, relative to a household income, where even moderate fines can be a considerable cost for people on a low income. Penalties work best when they impact on a person's activities. If the perceived benefit of breaching the law is greater than the price of a fine then it will not work. On the other hand, if someone's license is taken away or the loss of points leads towards that possible outcome, then the instrument is more effective.

Sometimes a legal instrument is better seen as a deterrent rather than resulting in a pursuit of perpetrators to establish cause and blame. The penalties for causing a fire that results in damage to others are high in New Zealand, not just because of the associated fine and/or liability costs, but also because of the recovery costs for the emergency response. The permit requirement is a legal deterrent to people, but the potential cost of an escaped fire is a more powerful instrument for modifying behaviours. However, the process of seeking a permit also provides an opportunity to explain the responsibilities and conditions associated with the permit to the permit holder. It provides a one-on-one interaction that can support questions being raised and answers given about the intended use of fire and what actions can be taken to prevent it from getting out of control.

Box 2 Vignette: Using fire danger rating signs as a trigger to seek a permit
Permits are a legal instrument that not everyone will understand or think might be required when lighting a fire. This is a problem for all rural fire officers, even though they experience and deal with permit requirements differently in different places. Fire officers use different tactics or methods of bringing people 'into the office' or to apply online for a permit. The fire danger rating signs are used to trigger an appropriate action. In some cases, such as in the Auckland region, the fire danger rating sign has been altered to directly indicate when a permit is needed, e.g., by dividing the five ratings (NZ) into three that show whether there is an open season, a permit is

required or there is a ban on lighting fires. This approach, while considered an effective means of facilitating the necessary conversation between fire managers and fire users, was not supported by fire managers from other regions. The primary concern was a lack of standard recognisable signage across all regions that indicates the authority of a national body and provides a single consistent message. Nevertheless, once the trigger for seeking a permit has been activated, then a conversation about safe fire practice can be initiated. The fire manager can ask questions about intended use of fire and what conditions are likely to prevail, as well as contingencies the fire user can take if things get out of hand. This kind of interaction that occurs during the permitting process is a critical education of the fire user. Once this relationship is established, it is expected that a rural fire user will have the knowledge to effectively manage fire risk and safely light a fire on repeat occasions.

It is not clear whether the penalties that apply to escaped fires are an effective deterrent to not seeking a permit. However, some means of reminding people of the danger to others, or of the actions they can take to manage fire risk, is necessary. In the recent past, the cost recovery process has become a well-known deterrent for New Zealanders, but visitors and new residents are much less aware of this consequence. The decision to revoke this reparation has met with the reservation of some rural fire officers. The confusion arising from such a change may need to be managed carefully, for example, by raising awareness of all people in New Zealand that using fire carries risk. As a newcomer to New Zealand, information about where to find out about legal fire use requirements is critical. An understanding of unsafe fire practices and creating appropriate social norms around fire use may be better served through other means such as clear messages about what are safe fire practices and community engagement.

Legislation is a resource-intensive method of achieving behavioural change by having powers of enforcement attached, but it does have additional benefit as a deterrent. Laws are systems used to create the conditions through which people behave or adopt certain norms around rights and responsibilities. There are added benefits of hard instruments that can be used as a stronger deterrent, e.g., using testimonials of people who have suffered the consequences of an escaped fire that can reinforce a social norm, such as making sure a fire is completely extinguished before leaving it. However, such norms can sometimes backfire through what is known as the fundamental attribution error or bias, where people believe that others make avoidable mistakes or errors in judgment compared to one's own behaviour that can be explained in some other way, such as via contextual factors that limit one's response.

Our discussions with PRFOs illustrated the importance of permits and the permitting process in facilitating an exchange between permit seeker and permit authoriser. Both need to interact to discuss the desired behaviours (unlike the sign system, which does not provide any clear indication of what behaviours are desired). The problem, as it is managed by rural fire officers, is that they do not have access to people *not* seeking permits. Thus they try and use the roadside signs (and other communication methods, such as radio and newspaper advertising) as a trigger to get people to think about applying for a permit if they plan to light a fire as routine or normal behaviour, or even if they should be lighting a fire in the first place under the indicated conditions.

Environments

An appreciation that there are different environments and different regional approaches to engaging members of the public can help show how the fire danger message gets contextualised. The variation in websites and in use of the signs across regions indicate just how nuanced (or 'made to measure') communication methods are. Varied responses to the roadside signs and permitting regulations also reflect differences in regional contexts, such as how the weather conditions and fire danger environments differ from Southland to Northland. Such an appreciation provides an opportunity to rationalise the environmental factors that influence how rural fire managers engage with members of the public. Furthermore these environmental factors are not just about the natural or man-made environment, but also the social or cultural environment in which risk messages are conveyed. The situation in Northland provides an excellent example of how these factors matter. In Northland they are embracing responsible fire use as is reflected in the Northern Rural Fire Authority's website. There are other locally contextualised aspects of their

communication such as business cards that use an appeal to subtle humour, of what some might refer to as inappropriate, to raise the attention of their intended audiences.

Environments are local places. They are the natural and social conditions observed daily that create a mood and acceptance of the way things are. When people move from one environment into another, they may not be aware of changes in local culture and practice. This does present Rural Fire Authorities with the challenge of how members of the public can be made aware that local rules apply that may be different from what they are used to/where they come from, and that different approaches are designed to achieve the same outcome of a reduction in escaped fires and appropriate fire mitigation behaviours. This regional 'variation' may be seen as a problem in creating a nationally consistent message. However, there is another side to achieving consistency that is less about the delivery of the message and more about making it locally relevant. An effective communication effort reaches in, to connect with the values and concerns people have; it 'grounds' itself in people's experiences and is relevant to the things that they care about and pay attention to. However, it remains important to have a nationally recognised authority that gives credence to local rural fire authority efforts to influence local and visitor members of the public in responsible and safe fire practice and fire danger response.

Box 3 Vignette: Connecting associated concerns with desirable actions

In an example taken from another context of desired behaviour change, efforts directed at getting people to bring their cats inside at night to protect native species that cats are known to prey on, have been tested (MacDonald & Edwards cited in Mark-Shadbolt, 2017). Messages about the danger cats present to native wildlife were not seen as credible with people that owned cats who were not heeding messages to bring their cats inside at night. People would see their cats as gentle natured and not the night-prowling hunters that conservation authorities were saying they were. One way suggested by behavioural psychologists to address this was to find something that people connected with that drove their concern about pets and motivated them to change (MacDonald, 2017). This was found to be concern about their cat being run over by a car or injured in a catfight. So this message was seen as the most appropriate way to actually shift how cat owners behaved. Cats were brought inside to protect them from traffic at night whilst native wildlife such as the iconic kiwi were protected. Even though this may seem unethical or deceptive in changing behaviour, it is weighed up as having greater conservation benefit compared with the small (relatively inconsequential) role deception plays in shifting the cultural norms of cat owners.

Helping people find out or express what they value about their local environment can be an effective means of taking responsibility for protections against fire danger. However another means of shifting behavior can be influencing people's thoughts about the actions they are capable of taking to reduce the risk of losing things they care about.

Box 4 Vignette: Visualising and enabling actions through local salience

Each rural property has a unique environment that carries a varying degree of risk of fire ignitions or other dangers. Engaging people in a descriptive and experiential awareness of their properties' risks through a hazard assessment is another tool that can be used to change behaviour. This has been seen as particularly helpful in a US context for wildland-urban interface (WUI) properties. Here salience plays a key role in bringing out the fears and concerns of people to provide them with a set of actions which will also increase their self-efficacy in being able to respond. Such an interaction enables property owners to ask questions directly of the risk analysts about what they can do to protect themselves or reduce their exposure to fire risk. Furthermore, these engagements can help build trust between people and increase a sense of community in responding to fire danger. A similar approach has been to use a technique known as 'mud mapping', (AFAC, 2015) with people in their local environment, to identify fire danger hazards as well as escape pathways and safe areas where they can retreat to when fires get out of control. Place mapping and other visual techniques can enable people to think through the dangers around them and increase their situational awareness and capacity to act under emergency circumstances (Reid & Beilin, 2015). Such approaches are also useful in identifying

what ‘assets’ individuals and communities value most highly, providing fire agencies with information on where to focus their suppression efforts when overextended (G. Pearce, personal communication, Oct 2, 2017).

The vignette examples discussed here illustrate the importance of people seeing their local environments as somewhere they can and do interact with, and how changing one thing within this environment can be used to help drive an outcome in another. Following such examples, aesthetic systems that provide vistas or attractive views for households can also be seen as fire risks. When seen in this dualistic way, it is then possible to address these two aspects independently creating opportunities to maintain aesthetics whilst also reducing fire hazards. Property inspections in Canada and the US are proving to be not only a good vehicle to change individual’s practice but also a means of extending good practice in neighbourhoods. People that take on individual property assessments have been identified as people who then discuss their experiences with others and contribute towards the creation of social norms of fire readiness in their neighbourhoods. They are demonstrating the importance of self-efficacy in changing behaviour by making impossible things achievable through a few simple steps, such as pruning trees around houses and having clear driveway access for fire fighting vehicles, for protecting oneself against wildfire danger.

Risk windows

The ‘risk window’ is a powerful metaphor for grabbing the attention of members of the public exposed to fire danger when a significant wildfire event heightens awareness. It is the salience of such an event that can tip people into action when something that they value is threatened. Almost all of the fire officers interviewed recognised the salience of a fire event as an opportunity to engage communities. They did get better attention from members of the public and were often invited into communities to help explain what had happened after a significant fire event. Such incidents present opportunities to talk to people about changing something they do to protect themselves, others in the community, or their property. However, many of our participants felt that they did not do enough to act in this way, or that other issues (including further fires or operational reviews) quickly took their attention away from this opportunity. Several examples were offered about the importance of this window; however, no one could say how long this window of opportunity remained open for.

Another window of opportunity was identified when people entered a new region, where the placement of signs was critical to indicate that a different fire rating may apply or where they should go to get information. However, an even more powerful mechanism for creating appropriate social norms around fire use or fire danger was to provide new property owners or residents in a region with information about fire risk in that area. Some of our participants indicated that one of the local norms around the sale and purchase of rural properties was to exchange information between buyer and seller about fire management practices and resources such as the location of water tanks or water supplies on the property. As this was a local cultural practice, the repartee of questions and answers provided a template for possible use of others such as community fire wardens or real estate agents when selling to a non-rural buyer, e.g., as a lifestyle property purchaser or someone from overseas. Property transfer trends were showing an increase in these types of purchases, and so a window of opportunity to establish appropriate fire risk norms is pertinent. Other examples of guiding people’s behaviour in the right setting could be placing information in rental vehicles such as freedom campers or where international visitors were entering the country. Choice architecture plays a role here where a pertinent reminder in the right setting provides an appropriate trigger to nudge people’s behaviour towards desired outcomes, such as the windscreen stickers in rental cars that remind international visitors to drive on the left hand side of the road.

A third potential area for reopening the risk window was during the anniversary of a significant fire event, or perhaps even at the beginning of the fire season, to remind people of the salience of fire danger. The relevant advice here is that agencies become ready to take up opportunities when the risk window is open and that the organisation has sufficient resources to support fire officers in making the most of this opportunity to create and maintain appropriate fire risk behaviours.

Box 5 Vignette: Effectively engaging communities in personal risk reduction
Efforts to engage communities have been recognised in theory and practice to be an effective means of altering people’s behavior in New Zealand and in Australia (Julie Warren and Associates, 2011; Paton, Frandsen, & Middelton, 2013). Across Tasmania an approach was supported by the Fire Service to engage communities in

their own fire risk reduction efforts and while expensive it has been recognised as one of the most effective means of motivating change (A. Slijepcevic, personal communication, Apr 19, 2017). In some parts of New Zealand an engagement of existing community groups by offering timely presentations on fire dangers along with open discussion has proven to be an effective motivational approach. In one example, a standard form of content indicating the kinds of actions people can take to reduce their exposure to fire risk is supplemented by images taken from within the local districts to illustrate dangers. Here specific risks, such as the dryness of vegetated hillsides and operating machinery during the peak of heat in the day, are noted. Furthermore efforts have been combined to maximize the scope of hazards addressed with an audience, e.g., joining rural and urban FireSmart[5] and FireWise educational programmes or different kinds of emergency settings by bringing response agency staff into the one gathering. While not all audiences across different areas are equally responsive, using this approach has resulted in change, e.g., follow-up phone calls seeking more information and an increase in sales of smoke alarms (J. Foley, personal communication, Nov 10, 2017). There has also been an evidential reduction in escaped or unplanned fires where rural communities have been engaged. Such personal interactions work well but are not the only means used to encourage appropriate behaviours. Situated placement of signs in forested reserves, talking to media during the fire season on specific hazards (such as grass in guttering or dry hillsides), and encouraging local landowners to discuss local fire conditions are also means used to maximize the opportunities to reduce risk.

New communication methods

Finally, the importance of new technologies and approaches to communicating, e.g., through social networks are also worthy of attention. Although not avid users of social media, study participants offered examples of how they do connect to a network of local fire users and others in the communities that could provide an important vehicle for advocacy of good fire management or fire safety practices. They also could provide important networks to share information during a significant event, or under particularly high and extreme fire danger conditions. Thinking about communications and their different forms, including those that work well for different purposes, can help equip fire managers with an understanding of how effective they are being in communicating fire danger. Face-to-face interactions are seen as the best means of changing behaviour, especially as a two-way flow of information enables a better understanding of fire danger and an appreciation of contextual conditions that may influence the range of actions a fire-user may take to mitigate fire danger.

Box 5 Vignette: Empowering individual efficacy through new technologies

Smartphone apps, such as the Scion Fire Danger Today prototype and 'Fires Near Me' type apps used by fire authorities in Australia, are another emergent technology for communicating fire danger that can provide important information on what is appropriate to do under different fire danger conditions (G. Pearce, personal communication, Oct 2, 2017). Such new technologies, while still seen as too expensive or unfamiliar to be readily adopted by members of the New Zealand or visiting public, may be used more often in the future and become a communication tool that fire authorities use to interact with members of the public in a more situational way, e.g., providing updates on change in fire conditions.

Electronic fire danger signs are another adaptation of situated communication methods, in this case of traditional half grapefruit fire danger signs, that can be updated remotely providing the ability to alter signs without having to travel out and change them in person. Some of the electronic rating signboards currently used in Australia also have LED message panels that can provide additional messages such

[5] FireSmart is an educational programme, modelled on the US FireWise programme which has been designed to be implemented by local community champions about creating a fire safe environment around one's home or property. The programme has struggled to get the desired uptake in New Zealand, which is not perceived to have the same rural-urban interface (RUI) wildfire risks as parts of Australia and the United States. However that perception is challenged by rural fire authorities who have had to deal with an increasing number of RUI fire events over the past few decades, as evidenced by the most recent major RUI fire event on Christchurch's Port Hills.

as the fire season status or active fire information. These have the advantage of authorities being able to change the rating at the click of a mouse (as opposed to having to travel to the sign to change the arrow manually), thereby correcting the concern of information portrayed not being up to date and also increasing the efficiency of setting the rating across vast areas under the management of rural fire authorities (G. Pearce, personal communication, Oct 2, 2017). These kinds of new technologies put more power in the hands of the user and therefore can increase the efficacy of individual actions and decisions around fire danger. They enable opportunities to influence people's situational thinking about what kinds of fire danger exists and changes as conditions change. As these technologies evolve and become more sophisticated people can be alerted about the fire danger conditions as they move into an area of higher fire risk.

Fire managers did note the importance of having an appreciation of the local conditions in which fire is being used so that they can provide appropriate advice. However, this knowledge is not new (Fogarty, 1997). The point being that while this knowledge may be clear, there are still individuals and groups of the community that do not respond to the opportunities for a two-way conversation about fire danger by seeking a fire permit or changing something else they do to mitigate fire risk, such as ensuring that they have access to water should a fire get out of hand. There are also those in the community that do not use fire in the rural landscape, but can better protect themselves against the use of fire by others. Sometimes a lack of public response can be an issue of the timeliness of information about fire danger and whether people are actually receptive to learning about their personal exposure to fire risk.

Social networking, especially that using social media, is a challenge in itself for fire officers. It takes additional resources and can detract from fire officers getting on with the job of managing fires. A new position has been created nationally as part of the transition to Fire and Emergency New Zealand to address information and communication technology needs, including the use of social media in conjunction with traditional broadcast methods of television, newsprint and radio. However, this may not address the ability for local fire officers to influence people in their own communities to adopt appropriate levels of alertness and to practice safe fire use or risk mitigation behaviours. Some rural fire officers do use social media, albeit in a limited way. From one point of view, the time and dedication required to run social media effectively was not available to fire officers. There were at least two rural fire officers who were interviewed that noted having networks to send out pertinent information to be highly valuable. People that could be trusted to share messages with were an asset to the overall goal of eliminating the risk of rural fires becoming out of control. From this perspective, using social networks or even a phone app to connect people through a permitting process or via rural fire force volunteers could provide a valuable vehicle for guiding social norms. However this may only be useful on the proviso that fire managers and their trusted allies have agreement on desired behaviours.

Other ways of communicating to target specific groups through strategic use of advertising through websites, such as international travelers or adventurers, e.g., where they might be looking for camping areas or tramping sites such as Department of Conservation huts or backpacker hostels, could be useful means of increasing awareness and inclination to seek further information from rural fire authorities in different regions. Another possibility is for education of fire users (especially inexperienced ones new to the country or rural areas) in safe fire use to ensure they understand how to safely burn rubbish or light bonfires or campfires with adequate means of extinguishing them safely (e.g. through online videos). Plans are also underway for Scion fire researchers to develop face-to-face training of rural land managers in safe use of fire (i.e., controlled burns) that may be adapted for online video audiences. Such an approach could be extended to recreational or home users of fire, by teaching safe fire practices through real, hands-on fire training or training videos.

Strategic thinking on behaviour change experiences and opportunities

As was noted in the literature review (Grant, Hooper & Langer, 2016), a strategic approach to communicating fire danger and behaviour change is needed. Multiple approaches, used over prolonged periods, are most effective in realising the desired reduction in human-caused fires and their adverse impacts in the rural landscape. Changing behaviour is a complex process that depends on the cultural practice and social norms of people in relation to fire. However, evidence from studies of behavioural psychology indicate that behaviour can be shifted towards achieving desired outcomes, e.g., using salience, testimonial and self-efficacy to overcome heuristics and cognitive bias. Events can be a powerful

means of increasing the salience of behaviour change, and evidence of effective action can support appropriate changes in thinking, planning or practice.

The exchange between fire officers and those seeking a permit is an important means of modifying behaviours and equipping fire users with knowledge of what to do and how they can minimise the risks of a fire escape. Our research illustrates how the permit process is embedded in a wider system of hard instruments that work together to enforce appropriate behaviour. However, some complementary approaches to urging fire users not seeking fire permits to become permit seekers, such as testimonials or even a fire event, are also powerful instruments for changing behaviours.

The varied and nuanced approaches used by fire managers across different regions related to fire danger signs and other regionally branded approaches to communicating fire danger attempt to build on the environmental awareness that everyone has and which is influenced by local cultural practices. However, these approaches may not be as useful for newcomers to a rural area who may not appreciate the local cultural practices, and thus alternative means are needed to gain the attention and engage visitors from another region or tourists travelling across the country.

Opportunities for engaging with communities through risk windows, such as following a significant fire event, to change behaviour could provide a more timely application of tools such as FireSmart. Authorities need to be well supported with resources ready at hand to realise such opportunities. For example, having appropriate printed material, people ready to go into communities at this time, and perhaps even offering property assessments to provide specific action advice, could all help in changing behaviour around fire danger. Individual property assessments have been used internationally to overcome inaction and support a sense of self-efficacy amongst property owners in neighbourhoods that are exposed to fire risk.

Social networking is recognised as an important means of normalising behaviours and is used for seeking approval of one's peers or communities that share similar values. However, this can mean interactions can fail to reach the desired audiences outside of social networks that are less inclined to behave safely. It is clear that different one-way communication methods such as signs and information delivery, along with two-way interactions, are useful for different reasons. Raising the awareness of visitors to the country or even people travelling from one region to another may be needed in the first instance. However this ought to be a trigger for people to seek further information. Although not a social networking effort, the 'Check it's alright before you light' campaign goes partway to achieving this. However, concern remains that this message is not clear enough, and that an agreed sense of what the desired behaviours are is needed, so that they can be conveyed consistently and people know what to do across a range of contexts throughout New Zealand.

Concluding Remarks

This inquiry proposed to introduce a broader lens to the communication of fire danger as part of wider community engagement, and sought novel approaches to risk communication which are inclusive of varying audiences. In essence, fire danger warning signs need to be seen as part of a larger communication effort. However, there is a need to see different communication activities as interconnected. This does not mean that they all have to use the same language or mechanisms for achieving change, but they do need to have some higher level of coordination in supporting a transition towards more constructive engagement of audiences to realise behavioural change.

Fire agencies must be prepared to use multiple approaches and over prolonged periods. Behaviour change is complex. Events can be powerful triggers, and messages can be designed to support development and adoption of social norms in response to events. Fire events and other risk windows provide opportunities to interact with people about their exposure to fire danger and support greater self-efficacy in taking actions to protect property and life. However, sustaining attention to fire danger requires persistence in raising awareness with changing environmental conditions. Reviewing the evidence of what methods work in changing behaviours, and enabling research to facilitate an appreciation of evidence for the context being worked within is important.

The literature reviewed and interviews conducted suggest there is no silver bullet for communicating fire danger to resulting in lasting behavioural change. Rather there is a need to develop a combination of approaches to create complementary efforts at local and wider scales including legislated (compulsory) requirements, support of local management programmes, and multi-participant education for neighbourhood uptake.

There may be some concern amongst communities and leaders, including authorities and experts, that a consistent message means a precise measure of risk and that the same approaches need to be applied in different settings. However, this is less important than getting people to feel they have a sense of responsibility to take action and to learn about the conditions in which fire danger is more likely to impact on the safety of their activities or motivate them to act. Being 'on message' means sharing a commitment to acting according to environmental conditions. Tailoring messages to suit the audiences' level of knowledge or needs for information that may impact their personal safety or the safety of others is important. However, the degree of flexibility in reaching diverse audiences, and the need to use multiple and diverse means of changing behaviour that may take place over an extended period of time, also requires strategic thought and commitment. Understanding what the most desired behaviours are is a step towards better designing messages to achieve changes in behaviour in different settings.

Internationally, much of the language has now shifted towards learning to live with fire and to become more adapted to fire as a regular part of the landscape (Moritz, Batlori, Bradstock et al., 2016; Shindler, Toman & McCaffrey, 2010; Donovan & Brown, 2007). This means increasing resilience to fire in the landscape by mitigating the effects of fire through management of fuel loads and improved community engagement in fire risk reduction. While the New Zealand context differs from these international experiences, as we do not need to use fire for managing native forest health and reducing fuel loads to the same degree, there are higher level concepts of engaging communities in fire risk reduction and self-reliance to protect life and property that are valuable for communicating fire danger in New Zealand. Nevertheless, it would be remiss to assume to know the specifics of local knowledge in fire use and capacity to manage fire in all areas and regions. The international literature and interviews conducted suggest that New Zealand aligns with other countries in addressing concerns about communicating fire danger and changing behaviour – every country is grappling with this complex task.

Combined aspects from the literature review, that link communication methods with behavioural change insights, are offered in Appendix A, which provides some illustrative examples to initiate discussion for developing a practical behaviour change toolkit. This is not a comprehensive listing, but does provide a starting point for further development through interactions with fire managers and researchers to think about areas of potential intervention in supporting the use of communication methods to reduce the likelihood of human-caused fires. It is presented as a thinking tool for reflecting on the key rural fire user groups, to better understand the effectiveness of communication efforts and to consider how they can be designed to achieve desired outcomes. The toolkit offers a basis for engaging with fire managers and researchers to discuss and explore possible design considerations for communicating fire danger using a suite of methods suited to the variety of fire danger contexts in New Zealand**.**

Recommendations

Langer and Hart recognised the communication needs of different audiences that the NZFSC might like to target (see Table 4). Following on from this advice, a strategic approach to thinking about the roadside fire danger signs is suggested in relation to a wider set of communication methods. Consideration needs to be given to how roadside signage can be better reconciled with these other communication methods as targeting different groups and audience types, as well as how they work together to achieve an overall improved response to communicating fire danger by enabling constructive interactions with members of the public to minimise or reduce fire risk.

Table 4: Recommended communication methods targeted for different groups and audience needs (abridged and adapted version, Langer and Hart, 2014, pp. 7-9)

Audience	One-way broadcast	Direct through conduits	Two-way dialogue
Rural and semi-rural fire users *Key messages:* *Awareness* *Information* *Prevention* *Preparedness*	National campaign, leaflets, **fire season & fire danger signage**, local media, websites, social media	Emails and texts, targeted conduits, community participation	2-way dialogue with individuals, 2-way dialogue with groups, community participation
Recreational and visitors *Key messages:* *Awareness* *Prevention*	National campaign, leaflets, **fire season & fire danger signage**, local media, websites, social media	Emails and texts, targeted conduits	2-way dialogue with individuals, 2-way dialogue with groups
Cultural users *Key messages:* *Awareness* *Information* *Prevention* *Preparedness*	National campaign, leaflets, **fire season signage**, local media, websites, social media	Emails and texts, targeted conduits, community participation	2-way dialogue with individuals, 2-way dialogue with groups, Iwi participation
Non-fire users *Key messages:* *Awareness* *Preparedness*	National campaign, leaflets, **fire danger signage**, local media, websites, social media	Emails and texts, targeted conduits, community participation	2-way dialogue with groups, community participation

Signs need to be a trigger set within a wider set of communication efforts, as part of a more comprehensive strategy for increasing capacity to respond to fire danger warnings. Understanding behavioural responses and what drives members of the public is important to work more meaningfully to change them. We offer the following set of lessons for the Fire and Emergency New Zealand to share with their rural divisions to increase awareness of how to shift behavioural patterns using a suite of communication tools and to better target the activities of people to enable triggers that can reshape practices.

Key lessons learned

The key lessons learned are as follows:

i. Behaviour change takes time and requires prolonged and multi-pronged efforts to support the transition towards a more responsible and responsive public in risk management and safe behaviour.

ii. Signs are a trigger for behaviours, but not the only mechanism needed for increasing the chances of people adopting appropriate behaviours.

iii. Social norms play an important role in facilitating desired behaviour, and ‘nudge’ approaches can be a powerful means of developing appropriate individual responses to fire danger.

iv. Face to face efforts are most important for improving the development of appropriate social norms and recognising the weaknesses of current behaviours.

v. Attention could be given to messages that trigger desired behaviours rather than reinforce inappropriate social norms, given that the way the message is framed makes a different to responses.

vi. Social marketing activities could be encouraged where appropriate, such as utilising local leaders and motivated individuals to assist in supporting behaviour change in others.

vii. Finding appropriate conduits for reaching diverse audiences also plays a role in supporting individual recognition that they are a target audience.

viii. Interactive processes in which people are engaging in their own planning efforts reach a level of local awareness to support greater preparation and capacity for community recovery following a wildfire or another natural disaster.

ix. Education initiatives work best when led through a capacity building approach where people are involved in shaping their own learning and lessons.

x. Real events provide important reality checks for people to reflect on and learn about what they are doing that works well and what does not.

xi. A wider community-based reflection on practical efforts and change in behaviours together with agencies provides an opportunity to build relationships that better define roles and responsibilities and increase levels of coordination.

In this research we have explored different approaches to convey fire danger information for engaging various groups within communities on how to be more aware, use fire or fire-causing equipment safely, and protect themselves against wildfire risk. Furthermore, we have considered how effective various communication approaches have been in changing public behaviours in relation to fire danger internationally, with a particular focus on their appropriateness for New Zealand. We have reflected on the strengths and weaknesses of different communications approaches to engage New Zealand fire managers in strategic thinking about a fire risk reduction communication framework suited to the New Zealand context. Our work contributes to a broader body of work on the effectiveness of risk reduction communication methods, and further informs the NZFSC on measuring the performance of communication efforts in changing the behaviour of people posing a risk of causing wildfires in New Zealand.

Practical recommendations

This study has aimed to provide a set of practical recommendations for Fire and Emergency New Zealand to implement as constructive measures of increasing appropriate rural fire risk reduction and emergency response behaviours.

1. Decide what behaviours are expected under different fire danger ratings and create a clear and consistent set of guides to support the realisation of those behaviours;

2. Introduce property risk assessments as a low cost measure to inspect properties and identify hazards that could be readily modified by property owners, increasing their self-efficacy;
   - Extend the opportunity provided by property level assessments and share information at an outdoor event such as a neighbourhood barbecue to increase appreciation of environmental fire dangers and self-efficacy of property owners in modifying risks;

3. Respond to risk windows as windows of opportunity, e.g., after a fire event to engage with exposed communities and build on the salience of the event to support individuals taking actions to change behaviour;
   - Alternatively look at other risk windows, such as when newcomers such as lifestyle property purchasers or renters move into an area, for local RFA officers or community fire wardens to

visit them to discuss fire danger and responsibilities such as permitting and cost recovery for escaped fire damage and what fire safety resources are available;

4. Recognise the value of liability and permit requirements as hard instruments to gain compliance rather than costly measures for catching culprits;

5. Explore the role of fire safe individual actions and neighbourhoods as reducing insurance costs to address the perception that higher fire risk areas such as the RUI may reduce property values;

6. Work with community groups including local fire force volunteers, other group chairpersons or community fire wardens to support the development of appropriate social norms around safe fire behaviour;

7. Develop opportunities for using social media with those who have experiences on appropriate behaviours to spread the word through people in the community (e.g., fire force volunteers) on actions that can be taken as well as pertinent information during very high and extreme fire danger periods;

8. Target visitors and freedom campers via appropriate websites and rental car companies to outline rules and regulations of fire permitting and compliance requirements as well as where to get further information; and

9. Explore the use of symbols as a universal language to convey a clear and simple message about fire permit requirements and fire danger similar to the total fire ban symbol of a fire within a red circle and a diagonal line through it, e.g., for national use including TV weather fire reports.

Future work recommended based on some of the data collected for this report is to:

- Further develop international crowdsourcing efforts to evaluate the complex issue of achieving the best results and measure the success of various methods in bridging the gap between communicating fire danger information and the fire danger status with meaningful behaviour change.

- Test some of the recommendations through engagement with rural fire officers and develop means for exploring an appropriate set of messages for the fire danger rating signs as well as wider appreciation of fire use requirements within New Zealand and across its different regions with visitors and new residents.

As this work has derived a few key recommendations for Fire and Emergency New Zealand at a time when the fire services in New Zealand are in a state of transition, further reflection and evaluation on desirability and feasibility of recommendations is also pertinent.

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Appendix A: Behavioural Change Practical Toolkit*

*This 'toolkit' has been developed as an illustration to initiate discussion with fire managers as to which of these approaches might be applicable to a New Zealand context of rural fire management. It has been developed for further consideration in relation to international experience of fire managers and researchers in effective communication methods that result in desired behaviour change.

Table 3. Examples of practical approaches from fire and non-fire settings taken from the literature review. The last column provides suggested applications for integration into fire danger and seasonal status communication initiatives.

Approaches	Description	Fire Example	Non-fire Example	Suggested Application
Self-efficacy	Self-efficacy is a person's belief that he or she has the capability to successfully perform a particular action to bring about an expected outcome.	Place mapping (Australia) as a community engagement tool to help individuals think about their local environment and how they interact with it with respect to fire danger (Reid & Beilin, 2014; AFAC, 2015). NED (& NED-2/3) US decision support tool initially developed as a forest managers' tool that has been adapted into a DIY risk assessment. Software of 2D or 3D representation of house or household environment that gives suggestions for management (Kropp, 2009).	-	Behavioural change initiatives can amplify individuals' self-efficacy by making certain behaviours seem achievable using testimonials of others who have changed their behaviour successfully and clear instructions regarding the uptake of relevant skills. Engaging with a situation in situ where the discussions are context-specific and enable critical reflection on how an environment or situation may be managed differently. RUI/WUI web-based decision support tool. Lifestyle communities that don't necessarily have fire management/prevention knowledge or experience.
Legislation and regulation	Conventional policy instruments that compel us to behave in a particular way.	Vegetation ordinances (e.g. by-laws) as positive tools to get compliance in managing fuels loads amongst neighbourhoods and also involve engagement with authorities to ensure equal treatment for all landowners/	-	Where there is a high level threat to lifestyle across a set of people in an environment and where compliance benefits all. RUI/WUI or isolated communities or people using public spaces such as camping grounds that benefit from greater compliance

		land managers (Wells, 2009; Vogt, Winter & McCaffrey, 2010). Liability costs of having caused a fire are an important disincentive for people not to comply with safe fire practices. Testimonials of people who have caused significant fires (even unwittingly) that result in cost recovery provide a powerful message to people to ensure they understand the conditions in which fires can escape.		and where use of penalties ensure high levels of compliance. A licence perhaps to light fires in certain areas where access might be an issue.
Systems thinking	Interrelationships between influencing factors of a complex behaviour are analysed as part of an overall system. Influencing one factor will impact on the rest of the system.	-	Stiff consequences, evolving social norms and directed advertising have been targeted in a systemic approach to reduce drink driving behaviour significantly in recent years.	This capability allows us as practitioners to anticipate the effects of potential initiatives, as well as providing a comprehensive representation of the influences on behaviours.
Habit	Over time, a repeated behaviour will become more and more habitual and this automaticity develops into a key driver for our day-to-day behaviours.	-	The British Heart Foundation's Fatty Cigarette campaign attempted to create an 'emotional stir-up' by emphasising the association between the cigarette and the damage it causes. The purpose was to force a smoker to think about the damage smoking causes every time he or she considered having a cigarette, essentially turning smoking into a conscious action rather than unconscious habit.	An 'emotional stir-up' is required to raise the habit to conscious scrutiny and break it. Choice architecture, mandated decision or having a choice made for you, depends on the complexity of the choice behaviour you are trying to change.
Emotions	Provoking emotions can act as a prompt for changing behaviours.	-	Curtis, Garbrah-Aidoo and Scott (2007) reported on their attempts to promote the use of soap in handwashing in Ghana using feelings of disgust.	Using fear or sadness to prompt action through graphic accounts of loss or infrastructure access. However overuse of emotion can be negative where it gets too much and

				de-emotionalises the intended audience, e.g., warning fatigue where people stop responding positively to messages.
Social norms	The customary 'rules' that define and govern acceptable behaviour within a society or group.	Local-level policies designed to help homeowners create fire safe environments with local rationalisations to pull down funding to support local action. Homeowners are seen as more acceptable of policies that are seen as fair and part of a more comprehensive risk reduction strategy (Winter et al., 2009).	An experiment involving hotel guests conducted by Goldstein, Martin and Cialdini (2007) found guests exposed to the message highlighting the desired social norm were 26% more likely to reuse their towels.	Some methods of achieving widespread awareness of a target social norm are as follows: (1) peer-to-peer approaches through word of mouth, online forums and communities; (2) testimonials from others who have adopted a behaviour; and (3) respected opinion leaders as 'ambassadors' for a behaviour. Additionally, social norms transform gradually over time.
Salience biases	Information that is conspicuous, novel or seems appropriate is more likely to shape our actions.	Publicising the adverse events such as loss of life or property in NZ, e.g., helicopter crash in Karikari Peninsula caused by smoke during emergency evacuation procedure. Loss of access to road, water or electricity, how would that effect your decision to prepare for fire (Wilson, 2016)? Recent events such as the Port Hills fires provide a powerful reminder to people that assumptions can be wrong. Many considered NZ not to have the right conditions for extreme or RUI fires; this event changed that with 400 evacuations and 11 properties lost/ damaged including a major multi-million dollar tourism infrastructure investment.	-	Salience can be manipulated by rearranging or introducing factors into the physical environment/decision scenario. In some cases unanticipated events replace the need to create a scenario or manipulate a set of circumstances to encourage reflection on decision-making assumptions.
Status quo / Inertia biases	Humans have a natural preference for the default	FireSmart (2004) as a tool has not been taken up in NZ. Defensible space considered only appropriate in certain circumstances. Conflicting objectives	-	Give some thought to strategies for overcoming inertia, for example, by making the behaviour seem easier to undertake than people perceive it to

	option or status quo (inertia).	with aesthetics, visual amenity of household areas, perceived safety of current landscape, etc. The application of such approaches to overcoming inertia may be better suited at times of heightened awareness such as immediately following an event like the recent Port Hills fires.		be, or by setting the default as something to opt out of rather than opt in to (Thaler & Sunstein, 2008). People are a lot more motivated for a period of time after a significant event that challenges their assumptions about safety or preparedness.
Environment	If a person's local environment contains barriers to a desirable behaviour, then it is unlikely that interventions targeting that behaviour will succeed in changing it.	Clearing vegetation that then needs to be disposed of requires roadside collection to help people execute action in controlling their defensible space, i.e., supportive action to achieve the desired behaviour. Legislated co-planning through Community Wildfire Protection Plans introduced as part of the Healthy Forest Restoration Act (2003) has contributed to addressing environmental limitations to adopting pro-active behaviours in relation to locally defensible space (Winter et al., 2009).	-	In general terms, local and macro environment factors that influence behaviour are most often addressed by policy changes or service provision. Expecting errors and having tools to manage them might be something appropriate for a NZ context where the environment lacks resources to deal with fire escapes, e.g., placing sand in camp grounds for putting out campfires prior to leaving; or selling water bladders or fire extinguishers at fuel stations where vehicles or machinery likely to cause spark fires might be refuelled.

Appendix B: Responses sought to four questions via email and semi-structured interview

Local
We would like you to comment on the EFFECTIVENESS or otherwise of any INITIATIVES that have DEMONSTRATED their usefulness/REAL IMPACT for residents and visitors to rural areas at ANY SCALE.

1) What methods of communicating fire danger have you observed that result in effective behaviour change?

2) What methods of communicating fire danger have you tried and what effects have you noticed?

3) If not limited by resources, what method/s do you think it would be worth putting effort into?

4) Is there anything else that you would like to add that you think could help us with our inquiry?

International
We would like you to contribute to our inquiries by allowing us to call you and ask your views in response to the following questions.

- Approaches that have DEMONSTRATED their usefulness/ real impact through a CHANGE in thinking/ practice/ behaviour around rural fire (or other natural hazards) for residents and visitors to rural areas at ANY SCALE.

- Approaches may be regulatory, simple signage, face-to-face, online information, mass media, social media, comprehensive media campaign, or any other innovations (e.g. in community engagement or public education) to communicate wildfire danger.

- Your comments on the EFFECTIVENESS or otherwise of each INITIATIVE.

    1) What methods of communicating fire danger have you observed that result in effective behaviour change?

    2) What methods of communicating fire danger have you tried and what effects have you noticed?

    3) If not limited by resources, what method/s do you think it would be worth putting effort into?

    4) Is there anything else that you would like to add that you think could help us with our inquiry?