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Children's knowledge of bushfire emergency response

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Abstract. In the aftermath of the Black Saturday bushfire disaster, the Victorian Bushfires Royal Commission recommended that bushfire education be made a formal part of the Australian national curriculum. Crucially, the success of any hazards education program depends on the degree to which the learner's existing knowledge and experience is accommodated in the education process. Yet accommodating children's knowledge in bushfire education is hampered by a lack of research on how children conceptualise bushfire hazards. To address this gap, this paper presents a detailed qualitative analysis of children's knowledge of bushfire hazards with a specific focus on emergency response. Across four bushfire-prone locations in south-eastern Australia, 26 focus group interviews were conducted with 87 children aged between 8 and 12 years. To better understand the construction of children's knowledge, individual interviews were also conducted with 37 parents. Through their engagement in the research process, children demonstrated a capacity for engaging in serious discussions about bushfire hazards and although their knowledge was often characterised by gaps and misconceptions, they also demonstrated a capacity for understanding the fundamental principles of emergency response, particularly when they had been involved in bushfire planning within their household.

Additional keywords: emergency management, hazards education, wildfire.

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Introduction

On 7 February 2009, bushfires (wildfires) burned 450 000 ha of Victorian bushland, killing 173 people (including 27 children) and destroying over 2000 homes (Teague *et al.* 2010). In the immediate aftermath of what is now referred to as 'Black Saturday', the Victorian Government established the Victorian Bushfires Royal Commission, which attributed the magnitude of losses to a fundamental lack of bushfire knowledge and awareness within the affected communities (Teague *et al.* 2010). Identifying bushfire education for children as the most effective means of addressing this issue, the Commission's final report included a formal recommendation for bushfire education be integrated in the Australian national curriculum (Teague *et al.* 2010).

However, the success of any hazards education depends heavily on the degree to which the learner's existing knowledge is accommodated in the education process (Twigg 2004). For several decades, scholars have argued that when hazard education is designed without regard for how different groups understand and experience hazards, it fails to achieve the kind of learning that facilitates protective action (Perry and Mushkatel 1986; Handmer and Penning-Rowsell 1990; Twigg 2004; Haynes *et al.* 2008). Respecting and accommodating the knowledge of the learner is also the central tenet of several prominent psychological theories that emphasise the influence of existing conceptual networks on the interpretation of new information and novel situations (Donaldson 1978; Von Glasersfeld 1991; Bruner 1996; Piercey and Berlyne 2001; Kushnir and Xu 2012).

Yet accommodating children's existing knowledge in bushfire education is severely hampered by a distinct lack of research on how children conceptualise bushfire hazards. In recognition of this research gap, this paper presents a detailed qualitative analysis of children's knowledge of bushfire hazards with a specific focus on emergency response. The paper begins with a review of the existing literature on children's knowledge of hazards and disasters and the Australian approach to community bushfire safety. It then outlines the Grounded Theory methodology and child-centred research methods that were employed to gather and analyse the data. Next, it presents key findings and discusses their implications for children's bushfire education. The paper concludes with a call for increased child participation in emergency bushfire planning both at school and within their households.

Children's knowledge of hazards and disasters

Historically, children have been largely excluded from the international hazards and disasters research agenda (Anderson 2005; Peek 2008). Over the last several years, however, there has been a substantial increase in child-centred research outputs (cf. American Bar Association 2009; Kilmer *et al.* 2010; Shaw *et al.* 2012). Although a substantial proportion of this research has focussed on children's psychosocial adjustment in the aftermath of disaster (Masten and Narayan 2012; Pfefferbaum *et al.* 2013), a small but growing body of research has focussed specifically on children's knowledge and education (Ronan and Johnston 2005; Mitchell *et al.* 2008; Finnis *et al.* 2010; Haynes *et al.* 2010*b*; Ronan *et al.* 2010; Shaw *et al.* 2011; Ronan and Towers 2014).

In the most empirically rigorous studies to date, Ronan and colleagues (Ronan and Johnston 2001; Ronan *et al.* 2001; Ronan and Johnston 2003; Finnis *et al.* 2004; Finnis *et al.* 2010; Ronan *et al.* 2010) used quantitative questionnaire-based methods to investigate the influence of school-based hazards education on a range of variables, including children's knowledge of protective response behaviours for various hazards (i.e. floods, storms, structural fires, earthquakes, snow storms and tsunami). For each hazard, 5- to 12-year-old children were presented with a list of correct and incorrect protective response behaviours and were asked to indicate which behaviours they would endorse in the event of that hazard. Across studies, children who had participated in school-based hazards education endorsed an increased number of correct behaviours and a decreased number of incorrect behaviours. Additionally, more accurate knowledge of response behaviours was associated with a reduction in hazard-related fears, which is consistent with the wider literature on childhood fear and anxiety (Gullone 2000; Klein 2009).

Although the New Zealand-based studies highlight the benefits of school-based hazards education, the exclusive use of quantitative questionnaire-based methods warrants some discussion. In recent years, it has been argued that quantitative methods restrict the researcher's ability to capture a detailed understanding of children's knowledge and experience because *a priori* theories and generalisations of adults are imposed on the data (Woodgate 2000*a*, 2000*b*; James and Prout 2004; Corsaro 2005; Greig *et al.* 2007). Yet it can never be assumed that children's knowledge will resemble that of adults. Indeed, child-centred research outputs have demonstrated that discrepancies often exist between the personal meanings that children and adults attribute to actions and events (Greig *et al.* 2007). Thus, inductive, qualitative research that enables the emergence of children's own perspectives on hazards and disasters is needed.

Community bushfire safety in Australia

The general philosophy underlying the Australian approach to community bushfire safety is that those at risk should play an active role in managing and reducing that risk (Handmer and Haynes 2008). For many years, the centrepiece of the community safety approach has been the 'prepare, stay and defend or leave early' policy (PSDLE) (Tibbits *et al.* 2008; Australasian Fire and Emergency Service Authorities Council (AFAC) 2012). Under this policy, residents are advised to either prepare to stay and defend their homes and properties, or prepare and leave well before a fire arrives in their area (AFAC 2012). The policy is based on substantial empirical evidence that (i) people are more likely to be killed by radiant heat or a vehicle accident while evacuating, and (ii) well-prepared houses can be successfully defended and provide safe refuge for people during the main passage of the fire front (Handmer and Tibbits 2005; Tibbits *et al.* 2008). Although these assumptions were scrutinised in the wake of Black Saturday, they were reinforced by the evidence presented to the Victorian Bushfires Royal Commission and the policy was retained (Handmer *et al.* 2010; Teague *et al.* 2010; Whittaker *et al.* 2013).

Although the PSDLE policy is empirically robust, an expanding body of research has identified fundamental problems with implementation (Tibbits and Whittaker 2007; Whittaker *et al.* 2013). Despite fire agencies' concerted efforts to educate the community, many residents living in high-risk areas eschew the binary approach of PSDLE in favour of dangerous 'wait and see' strategies (Whittaker *et al.* 2013). Numerous studies have shown that residents who plan to leave often wait until the fire has reached the vicinity of their property, while residents who plan to stay defend often retain late evacuation as a last-minute option (Tibbits and Whittaker 2007; Whittaker *et al.* 2013). To address this issue, Australian fire agencies have introduced a new 'Code Red' fire danger rating that is applied when the Forest Fire Danger Index exceeds 100 (Bureau of Meteorology 2014). On Code Red days, residents are advised to leave either the day before or early in the morning, even if they are well prepared to stay and defend (AFAC 2012). Yet a recent study of household responses to a Code Red rating found that very few residents left their homes in the absence of an actual fire threat (Whittaker and Handmer 2010).

Despite their well-documented vulnerability to bushfire disasters (McFarlane 1987; McDermott *et al.* 2005; Haynes *et al.* 2010*a*; Yelland *et al.* 2010), Australian children have been marginalised in both academic and political discussions of bushfire community safety. To date, no research has investigated how children understand bushfire emergency response and the only official advice relating to children is that they should not be present during a bushfire event (AFAC 2012). Although well-intentioned, this advice does not provide children or their families with the information they need to critically engage with bushfire planning. Nor does it reflect the reality that even under Code Red conditions, many people will continue to 'wait and see' (Whittaker and Handmer 2010). Thus, there is a need for evidence-based education programs that provide children with the requisite knowledge and skills for responding safely to bushfire emergencies. Understanding children's knowledge of bushfire response represents a crucial first step in that direction.

Research strategy

Grounded Theory methodology

Given the dearth of child-centred research in this area, this research employed a Grounded Theory (GT) methodology (Glaser and Strauss 1967; Charmaz 2006; Strauss and Corbin 1998, 2008). Grounded Theory is an inductive methodology for developing new theory that is rigorously 'grounded' in data (Charmaz 2006; Strauss and Corbin 2008). The rigour inherent in GT can be largely attributed to the three phases of coding: (1) initial coding – naming each word, line, or segment of the data; (2) focussed coding – sorting the most frequent initial codes into broader categories; and (3) theoretical coding – weaving the categories together to create a cohesive account of the studied phenomenon (Charmaz 2006). Throughout each coding phase, the method of constant comparison – comparing data with data, codes with codes, and categories with categories – further ensures a high level of analytic rigour (Charmaz 2006). Additionally, the assumptions and techniques of GT are consistent with contemporary theories of child development, making it an ideal methodology for researching children's knowledge (Woodgate 2000*a*, 2000*b*; Coyne 2006; Sartain *et al.* 2008).

Qualitative methods

Although qualitative methods have not traditionally been viewed as an appropriate choice for research with children, the social sciences are now more accepting of children as reliable informants who are more than capable of providing accurate accounts of their own knowledge and experience (Qvortrup 1994; Curtin 2001; James and Prout 2004; Greig *et al.* 2007). At the same time, conducting qualitative research with children poses some unique challenges. One issue pertains to children's still-developing communication abilities (Greig *et al.* 2007). Another pertains to the power differential that exists between child participants and adult researchers (Eder and Fingerson 2002). In the present research, children's communication abilities were augmented through the use of the 'draw and write' technique, in which children draw a scenario and then write or talk about what is happening in their picture (Pridmore and Lansdown 1997; Horstman *et al.* 2008). Meanwhile, the power differential was reduced through the use of focus group interviews, which are said to increase children's confidence in expressing their viewpoints, presumably because children are more at ease when they are among their peers and outnumber the adults in the setting (Eder and Fingerson 2002; Hennessey and Heary 2005).

Data collection and analysis

Focus group interviews with children were conducted in two primary schools in Tasmania (Bothwell District School and Huonville Primary School) and two primary schools in Victoria (Macedon Primary School and Warrandyte Primary School). The schools were selected on the basis of two main criteria: (1) the location of the school was identified by the relevant state fire authorities as one that could be impacted by a bushfire event; and (2) there had not been a major bushfire in that location in the lifetimes of the children living there. The main reason underlying this second criterion was that a major bushfire in any particular location is a relatively infrequent occurrence. Thus, education programs must be informed by analyses of how children understand bushfire emergency response in the absence of any direct experience with a major bushfire event.

On agreeing to participate in the research, school principals were contacted and times for classroom recruitment presentations were arranged. Across the four schools, 87 children aged between 8 and 12 years participated in 26 focus group interviews. Male to female ratios approached 1 : 1 with 40 males (46%) and 47 females (54%). To gain additional insight into the construction of children's knowledge, 37 individual interviews were conducted with parents of the child participants. Parents' ages ranged from 32 to 47 years with an average age of 41 years. Females were disproportionately represented with 31 females (81.1%) and 6 males (18.9%). This is explained by the fact that many of the female participants were either taking leave from work or working part-time in order to raise their young families and this made it easier for them to participate.

Tasmanian focus groups and parent interviews were conducted during the months of September, October and November in the lead-up to the 2007–08 bushfire season. Victorian focus groups and parent interviews were conducted exactly 1 year later, during the months of September, October and November in the lead up to the 2008–09 bushfire season. Thus, all data collection was completed prior to Black Saturday. The number of participants in each focus group ranged from three to five children, which is considered an ideal size for maximising discussion, yet still maintaining order (Peek and Fothergill 2009).

Focus groups with children were structured around a scaffolded scenario that commenced with receiving a warning about a bushfire in the area and concluded with a fire moving over the property.[1] All children were given the option of using the 'draw and write' technique to assist them in communicating their thoughts and ideas. In the parent interviews, participants were asked to describe their household bushfire plan and the extent to which their children had participated in household bushfire planning. Focus groups were video-recorded and parent interviews were audio-recorded. All recordings were transcribed verbatim and transcripts were analysed using the GT coding procedures described above (Charmaz 2006).

The research was approved by the Human Research Ethics Committee (Tasmania) Network, which adopts the guidelines of the National Health and Medical Research Council on Ethical Conduct in Research (National Health and Medical Research Council (NHMRC) 2014). Approval to conduct the research in schools was granted by the Victorian Department of Education and Training and the Tasmanian Department of Education.

Research findings

Through their engagement in the research process, the children demonstrated a distinct capacity for engaging in serious discussions about bushfire hazards. They were highly aware that there could be bushfire in their area and they clearly understood the importance of planning for bushfire emergencies: "People need to have plans. Before there's a fire, they need to have plans" (Taylor, 9 years, Macedon). Consistent with previous research (e.g. Finnis *et al.* 2010; Ronan *et al.* 2010), the children also suggested that knowing how to respond to a bushfire emergency helped to assuage their bushfire-related fears. For example, when asked if he was worried about bushfires in his area, Jared (8 years, Macedon) responded, "No, I'm not because our family's got a fire plan and stuff". Similarly, Michaela (11 years, Macedon) explained that "I want to know what I would have to do because then I would feel a bit more relaxed."

In the focus group interviews, children identified three main approaches to bushfire emergency response: *leaving*, *staying to defend* and *sheltering*. A detailed exposition of children's knowledge of each approach is set out below. The quotes presented have been selected because they most clearly represent children's knowledge of the concept or phenomenon in question. However, a more extensive selection of quotes can be found in Towers (2012).

[1] After each focus group, time was always taken to explicitly address children's misconceptions. Children were also encouraged to seek more information from their parents and teachers about bushfire emergency response and school principals were encouraged to engage with their local fire agency and take advantage of any school-based education programs on offer.

Leaving

Children's knowledge of leaving was structured around three key tasks: *deciding what to take*, *choosing a destination*, and *identifying triggers.*

The task of deciding what to take sprang from children's awareness that if they did leave, their home might be destroyed in their absence. When deciding what to take, children listed a wide variety of special belongings including toys, photographs, jewellery and other family heirlooms: for most children, however, it was pets that took first priority (Table 1).

Although most children planned to gather their special belongings when faced with an actual bushfire threat, some children had packed a 'firebox' in anticipation of a future event:

Dell: We've got a firebox in case we have to just get away. You get a cardboard box and put all your really valuable stuff in it, in case your house is burnt. (10 years, Bothwell)

The task of choosing a destination involved identifying a location that was perceived as being 'away' from any potential fire threat. Some children chose a destination in another town or city, where the home of friends or relatives would provide a safe refuge until the fire threat had passed.

Pete: The safest place for us to go would be to hop into our car and drive off to my mum's best friend's house up near NSW, about 5 minutes to the end of Victoria. It's in Kerang. So we would go up there and that's the safest place. (9 years, Warrandyte)

Other children, meanwhile, chose destinations much closer to home, such as the mailbox, the end of the driveway or a neighbour's house (Table 2).

The tendency to choose destinations so close to home seemed to be an artefact of school-based house-fire safety programs, which routinely include a homework activity whereby children develop a house-fire escape plan with their family (Country Fire Authority (CFA) 2014; TasFire 2014). Many of the parents interviewed explicitly acknowledged that it was this homework activity that had compelled them to develop a detailed plan:

Melissa: The children came home with an assignment where we had to work out a house [fire] plan. They took it really seriously so we sat down with them and worked out exactly what we would do, what our exit points would be and where we would meet outside. I couldn't believe we hadn't already done it: something so easy that could save our lives. (Mother of Fiona (9 years) and Colin (11 years), Huonville)

Crucially, however, when asked about their household bushfire plans, children often recited the details of what were undoubtedly house-fire escape plans:

Researcher: How many of you have a bushfire emergency plan with your family?
Sarah: We've got our meeting place, we do.
Kevin: Mum said that, like in my old house you'd knock over the like flyscreen, jump out that, then go round the paddock and meet at the front gate. (11 years, Huonville)

Moreover, when specifically asked if their house fire plans could be implemented in a bushfire emergency, some children responded in the affirmative:

Cate: Well, if when we see a fire, we all run out to the letterbox and mum says is everybody here and like there's only four

Table 1. Deciding what to take

Pets	Amy (9 years, Warrandyte)	We take Pixie, Spike and Kalu – our cats – because it would be hard for us to let them go because our cat loves us so much.
	Amber (10 years, Warrandyte)	Your pets! You would definitely take your pets!
Toys	Lucas (8 years, Warrandyte)	I'd get my Nintendo.
	Stuart (11 years, Macedon)	Well, we'd probably get ready to get into a car and stuff and grab some of our favourite things … Maybe some of my toys and that.
Photographs	Carl (8 years, Warrandyte)	I'd have to take all of my toys and photos.
	Max (11 years, Macedon)	I would probably take photographs because we've got a big box of just like old photo albums and stuff.
Sentimental items	Flynn (11 years, Macedon)	Just [take] stuff that you've had for a long time or that means a lot to you.
	Amber (11 years, Warrandyte)	There's this ring which has got grapes on it and I would take that because my Grandma passed it to my mum and my mum passed it to me.

Table 2. Choosing destinations close to home

The mailbox	Mark (11 years, Warrandyte)	I think if it was near our house we have to go down to the front of our house.
	Lana (11 years, Warrandyte)	You have to go to the mailbox.
	Mark	Yeah, straight to the mailbox.
End of the driveway	Dan (9 years, Huonville)	My escape plan will be if there was a fire you'd quickly get out and take your car up to the end of the driveway so you don't get burnt.
The backyard	Elle (10 years, Warrandyte)	If it's coming towards us, we've got a very big backyard so we have to run all the way up the backyard and we have to make sure everyone's safe.
Neighbour's house	Jane (11 years, Warrandyte)	Well, we don't have a very long driveway, so we'd just make sure everyone was out of the house and we'd go to our next door neighbour's house because our letterbox isn't like that far away from our house.

people, um, then she goes back in and finds them if they're still asleep.
Researcher: And are those plans for a bushfire or a house fire, do you think?
Cate: Both. (9 years, Warrandyte)

Ostensibly, children did not readily differentiate between house-fires and bushfires and, in the absence of any information to the contrary, they had assumed that their house-fire plan could be suitably applied to the bushfire context.

Identifying triggers involved deciding on the precise point at which the family should leave. Some children said they would leave as soon as they received a warning, even if there was no imminent threat.

Researcher: What would you do if there was a fire on the mountain?
Max: We'd probably leave to go to New Gisborne because fire is very hot.
Researcher: So you'd leave even if the fire was still up there?
Max: Yes. Well, just because my parents would probably not want to even take any chances. (11 years, Macedon)

Other children, by contrast, advocated a 'wait and see' strategy similar to that which has been identified in research with adults (Tibbits and Whittaker 2007; Whittaker *et al.* 2013). These children suggested that they would pack up their valuables and pets, but would only leave when the fire reached the vicinity of their property.

Researcher: What if the fire was still over up in the hills, what would you do then?
Brendan: Just leave it for a while.
Mike: Just stay. Stay and see what happens.
Researcher: While you were waiting, what would you be doing?
Brendan: Just watching the fire to see how close it gets.
Mandy: Get most of your stuff so you can go when it comes like really close to you. (10 years, Bothwell)

Children advocating this 'wait and see' strategy lacked an awareness of the dangers of late evacuation. For example, when asked what they would do if the fire was blocking their evacuation route, some children suggested they would go 'around' or 'through' the fire, reflecting a lack of knowledge about the intensity and magnitude of both smoke and radiant heat.

Claire: If the fire went up the hill, it could go in five directions: it could go there, there, there, and there and there, so it could straight to my house. But if it goes to my house, I could just go around it. (9 years, Warrandyte)
Thomas: You could probably just drive straight through the fire. It would probably only, like, peel the paint off the car and you could just drive a bit faster through the fire. (11 years, Bothwell)

Other children suggested fleeing in the opposite direction, reflecting a lack of knowledge about the speed at which bushfires can travel.

Claire: I would go around the pond but if there was a fire there, I would have to run the other way down the driveway. (11 years, Huonville)

Importantly, however, some children did understand the dangers of late evacuation and advised against trying to leave if the fire was too close.

Max: If like the fire was fairly close, you wouldn't really go on the road, because that's actually how a lot people died in Ash Wednesday; they tried to get out of their house and run away. (11 years, Macedon)

Some of these children also suggested that if it was too late to leave, they would initiate a contingency plan to stay and defend, which is consistent with the advice of Australian fire agencies (AFAC 2012).

Philip: If we're going to go, we'll take everything in the car but, if the fire's too close, we'll get everything into our front room, which is made of brick, and we thought we'd just get like wet mops and stuff to put out the fire if it gets too close. (12 years, Macedon)

As revealed in focus groups and interviews with parents, the accuracy and sophistication of children's knowledge of leaving was largely determined by their participation in household emergency planning. When children had been involved in planning activities and discussions, they tended to advocate leaving early to a destination that was far removed from the area under threat. For example, Stuart (11 years, Macedon) reported that "If there's a fire in the area, if we weren't at school, me and my brother and mum would go to Highpoint [suburban shopping centre] or something and my dad stays and defends the house". As Stuart's mother explained, she had tried to ensure that her children would know what to expect if they did need to leave:

Jan: Coming from the suburbs, we were really aware [of the risk] from the beginning, from the very day we moved in and we've tried to make that part of the kids' understanding as well. The children know that I'll take them and we'll go somewhere safe. You know, we'll make that decision early and we'll go somewhere safe. (Mother of Stuart (11 years), Macedon)

By contrast, when children had not been involved in household bushfire planning, they often chose a destination close to the house or advocated dangerous 'wait and see' strategies. For example, Debbie's mother admitted that she was 'not really comfortable with our plan because I don't think the kids are aware of what's needed and what would be required'. Indeed, Debbie's plan was to evacuate to her grandmother's house, but only when the fire had reached the vicinity of her property:

Researcher: If there is a bushfire that is a threat to your area, what do you do?
Debbie: We would get in the car and probably go to my grandma's house or something.
Researcher: Alright and under what circumstances do you get in the car?
Debbie: If like you could see everything and it was like really close, then we'd probably go. (11 years, Macedon)

Staying to defend

Children's knowledge of staying to defend was structured around three distinct phases of a bushfire event: *before the fire*,

as the fire approaches, and *when the fire arrives*. For each phase, children proposed various tasks and activities that were aimed at protecting life and property.

In addition to general property maintenance (e.g. removing trees, raking leaves, mowing lawns, cleaning gutters), tasks to be undertaken before the fire included ensuring a dedicated water supply for firefighting and obtaining firefighting equipment (Table 3). As will be noted, many children had observed these activities taking place on their own properties.

Tasks to be undertaken as the fire approaches included setting up the firefighting equipment, preparing additional water resources, and taking additional precautions to prevent house ignition (Table 4).

Although children's knowledge of what to do before a fire arrives and as a fire approaches was generally consistent with the advice of Australian fire agencies (AFAC 2012), their knowledge of how to respond when the fire arrive*s* was often misconceived. Many children suggested that they would fight the fire front itself with the explicit aim of preventing the fire from reaching the house. Moreover, if this proved unsuccessful, they would initiate a last-minute evacuation.

Con: Well, because our house is sort of protected, we'd try and start to put out this fire, yeah, the main fire because like we'll have spray packs on and they'll be full of water and because I sort of know how to drive a little car that we have and it's got a big water tank on there, so we can use that as well to try and put that fire out.

Researcher: What if the fire kept coming?
Con: If it gets really, really close, you have to evacuate. (9 years, Macedon)

These children not only lacked lack an awareness of the dangers of late evacuation, they also had misconceptions about the causes of house ignition. Although extensive research has shown that house ignition is predominantly caused by ember attack in the periods before and after the main fire front passes over (Leonard 2003; Blanchi and Leonard 2008), these children were adamant that if the fire front did pass over, the house would burn, regardless of the precautions that been taken to protect it.

Researcher: What will happen if a bushfire comes right up near the house?
Con: It's probably still gonna burn. If it gets really close, they have to hop in their car and drive away.
Researcher: But why wouldn't you stay if you've done all that work to get the house ready for bushfire season?
Con: If it gets too close you have to leave.
Researcher: So if the fire comes up close…
Con: Evacuate.
Researcher: Nothing is going to save the house?
Larry: No. Absolutely not. (9 years, Macedon)

However, there were some children whose approach to defending was highly consistent with the advice of Australian fire agencies (AFAC 2012): specifically, patrolling the property extinguishing embers and spot fires, sheltering from radiant

Table 3. Tasks to be undertaken before the fire arrives

Securing a dedicated water supply	Tom (8 years, Warrandyte)	In summer, we have these big like rubbish bins, like that tall, filled up to the top, I've got one at the end of the house, one out the back, I've got one here, one here, one here, and one here and one here too.
	Con (9 years, Macedon)	At our block we have got like um, we've got two dams that could hold about a million or so litres… hardly any of it's suitable for drinking but at least we've got lots for firefighting.
	Lisa (11 years, Warrandyte)	If you've got tanks, make sure they are full of water.
	Sam (11 years, Macedon)	We've got this big tank. I think it's about 50 000 gallons and then there's like a littler one which is like 30 litres or something and that's the firefighting one and that's like full.
Obtaining firefighting equipment	Larry (8 years, Macedon)	If you had a water tank you should put a hose near there so you could get it away from the water tank and spray it.
	Con (9 years, Macedon)	We've got lots of sprinklers that Dad's installed and on our house we've got lots of sprinklers.
	Lisa (10 years, Warrandyte)	You go out to Bunnings [hardware store] and you buy heaps and heaps and heaps of buckets.
	Philip (12 years, Macedon)	We've got a really powerful pump so we can spray water onto the fire.

Table 4. Tasks to be undertaken as the fire approaches

Setting up firefighting equipment	Stuart (11years, Macedon)	If we had a firefighting pump, get it ready.
	Annaliese (11years, Macedon)	Yeah and attach it to the tank.
Preparing water resources	Nina (10 years, Warrandyte)	You'd run and then fill the bath up with cold water and then you'd get all the buckets that are in the bathroom and fill them up and get them ready.
Wetting the house	Sam (8 years, Warrandyte)	I would get up and wash out the house and like get water on the house so when the fire comes it doesn't burn the house.
Filling gutters	Jared (8 years, Macedon)	We put the plugs in the gutters and then we fill the gutter up with water so then the embers go in and then get put out.
Closing doors and windows	Flynn (11 years, Macedon)	You could probably lock the windows up, well not lock them just shut them and probably block them up.
Sealing gaps	James (11 years, Macedon)	Put wet rags under the door and then you'd just look around for cracks everywhere like any sort of hole or crack and just block it.

heat inside the house as the fire front passed over, and then returning outside to extinguish any remaining spot fires after the fire front had passed.

Brian: If it's [the fire] around the house, then you start defending. You just start putting out the embers that fall near the house and if there's any spot fires you put them out.

Researcher: What would you do when the main fire was from here to the playground away [10 m]?

Brian: You'd go inside and you'd just wait until the fire front has passed… Because of the radiant heat, if you're still trying to put out the spot fires and everything, the heat will get to you… You'd stay in the middle of the house like as far away from the windows as possible and you move all the furniture into the middle and you'd wait until the fire front has passed and then you'd go back out and keep defending. (9 years, Macedon)

Although these children did not expect their homes to catch fire, they did propose contingency plans to be implemented in the event that a fire did take hold:

Brian: I have a backup plan, if your house starts burning and this might not happen, but like if you've got like an island in the middle of your dam, you could go to your island. Because it's going to be really hot and it will be really low so you could almost walk there or you could swim, it's not going to be very far. (9 years, Macedon)

The sophistication of children's knowledge of staying to defend was also largely explained by the extent to which they had participated in household emergency planning. For example, Brian (9 years, Macedon), whose perspectives are presented above, had been fully briefed on the intricacies of his household's plan to stay and defend, including how to respond when the fire arrived:

Sally: I think that the more information he had and the more I could explain, you know like, 'The fire front's only this amount of time and while it's happening we're inside we're safe, the rest of the time you're patrolling, you're putting out embers, it's understandable, it's manageable, the fire doesn't just land on your house and blow it up'. (Mother of Brian (8 years), Warrandyte)

By contrast, when children had been excluded from discussions about staying to defend, they were more likely to advocate last-minute evacuations. For example, Jane (9 years, Warrandyte), who planned to fight the fire front and then run down to the river when it reached the house, had been excluded from family discussions on the basis of her age:

Bob: I suppose we've probably tended to shield her a bit from it up to an extent. Maybe because she's just turning 9 this year, so it's probably that up until now we've thought she didn't really need to know about that to an extent… it's probably something that we need to think about. What is a good age to talk about it and that might be maybe 11 or 12. (Father of Jane (9 years), Warrandyte)

Sheltering

Unlike staying to defend, which involved active firefighting activities, sheltering involved taking passive refuge in a structure or location deemed to be 'fireproof'. Children's preferred structures and locations for sheltering fell into three main categories: *buildings*, *bodies of water* and *underground bunkers* (Table 5).

To consider buildings to be safe places in which to shelter, children had to be certain that they would fully resist bushfire impacts. Construction materials were considered to be the key predictor of resistance, and metal, brick and stone all ranked highly in children's assessments. Although construction materials do influence the likelihood of building ignition, other variables, such as structure design, preparedness of the property and human activities during the fire, also play an integral role (Blanchi and Leonard 2008; Blanchi *et al.* 2010). The critical role of human activity during the fire has been highlighted in two key studies of Australian bushfire fatalities (Handmer *et al.* 2010; Haynes *et al.* 2010*a*), in which over one-third of all bushfire fatalities were attributed to passive sheltering inside. For this reason, Australian fire agencies discourage passive sheltering in any building that is not a formally designated community shelter or bushfire refuge (AFAC 2012).

Children often perceived bodies of water (e.g. dams, swimming pools, rivers and bathtubs) as safe shelters because they believed that the water would act as a non-flammable protective barrier between them and the fire. Although previous bushfire

Table 5. Structures and locations for sheltering

Buildings	Lina (9 years, Warrandyte)	Maybe if there's a brick house somewhere that doesn't ever catch on fire, you could go there.
	Sam (11 years, Huonville)	We'd go to the chook [chicken] shed. Some of the chook shed is metal and it can't really catch on fire.
	Lang (12 years, Warrandyte)	If it [a bushfire] was coming from the State Park, we would run into the stone house.
	Scout (12 years, Warrandyte)	Because it's stone and there's no wood.
Bodies of water	Jessie (9 years, Macedon)	You could go in the dam because the fire wouldn't go into that.
	James (9 years, Warrandyte)	Go into the river… because it's all water and fire can't beat water and water can beat fire.
	Flynn (11 years, Macedon)	Maybe if someone else's house had a pool, you could go there and then if they had the fire coming, you could just swim in that the whole time because it won't burn.
	Steph (11 years, Huonville)	Get in the bath because if the fire came in the house, it wouldn't be able to get you because it wouldn't be able to go in the water.
Underground bunkers	Liz (9 years, Warrandyte)	We've got this space that's made out of… It's sort of like underground sort of so if there's a really big fire we could go in there.
	Researcher	Is it like a cellar?
	Liz	Yeah, it's sort of under the ground… There's just dirt around in it [so] it doesn't really catch on fire.

disasters provide examples where people have survived by sheltering in a dam, swimming pool or river, these locations do not provide sufficient protection from smoke or radiant heat and should only be considered as an 'absolute last resort' (AFAC 2012). Meanwhile, sheltering in the bath or bathroom is a major cause of bushfire fatalities (Handmer *et al.* 2010; Haynes *et al.* 2010). On Black Saturday, for example, 46 of the 173 fatalities had been sheltering in baths or bathrooms at the time of death (Handmer *et al.* 2010; Teague *et al.* 2010). Consequently, sheltering in baths or bathrooms is not recommended under any circumstances (AFAC 2012).

For the children in the current study, underground bunkers usually took the form of cellars located beneath the house. Cellars were generally viewed as safe shelters because they tend to be composed of non-flammable materials, such as dirt or cement. However, as research has shown, even if a bunker doesn't burn, occupants can be killed by the highly noxious gases that are emitted by other burning buildings (Australian Building Codes Board (ABCB) 2010; Handmer *et al.* 2010; Teague *et al.* 2010). Hence, Australian fire agencies strongly advise against sheltering in any bunker that has not been constructed according to strict building regulations (AFAC 2012). Even then, a bunker should only be viewed as a 'place of last resort' and never as a substitute for leaving early or staying to defend (ABCB 2010; AFAC 2012).

As noted earlier, some children viewed sheltering as a contingency plan to be implemented only when attempts at defending had failed. For others, however, sheltering constituted a first line of response. Children who viewed sheltering as a contingency plan had formed this view through their involvement in household emergency planning. However, the circumstances of children for whom it was the preferred mode of response were more ambiguous. Some children reported that their household plan, as developed by their parents, involved passive sheltering. However, the parents of these children were not interviewed, so this could not be verified. That said, previous research has found that in some households, sheltering is viewed as an appropriate first line of response (Handmer *et al.* 2010). Therefore, it is possible that these children were providing accurate accounts of their household plans.

Implications for research, policy and practice

The findings of this paper provide important insights into children's knowledge of emergency bushfire response and the processes that influence knowledge development in this domain. Through their engagement in the research process, the children in this study articulated their perspectives on three key approaches to emergency response – leaving, staying to defend and sheltering. For each approach, however, there was substantial variation in the accuracy and sophistication of children's knowledge. Much of this variation was explained by the extent to which they had been involved in household bushfire planning, which is consistent with a robust literature on the sociocultural nature of knowledge development (Cole 1996; Scribner and Tobach 1997; Rogoff 2003; Lightfoot *et al.* 2012). When children had been afforded a high level of involvement, they exhibited more sophisticated understandings that were largely consistent with the advice of Australian fire agencies. Importantly, age did not exert a direct influence on the sophistication of children's knowledge: however, in some cases, it had influenced parent decisions about the extent to which they had involved their children, suggesting that age is a key moderating variable.

When children had not been involved in household bushfire planning, their knowledge of bushfire response often comprised serious misconceptions. These misconceptions were frequently underpinned by flawed assumptions about the physical characteristics of bushfire hazards, highlighting the influence of existing conceptual networks on the interpretation of new information and novel situations (Donaldson 1978; Von Glasersfeld 1991; Bruner 1996; Piercey and Berlyne 2001; Kushnir and Xu 2012). When children underestimated the speed at which fires can travel or the intensity and magnitude of smoke and radiant heat, they tended to advocate dangerous 'wait and see' approaches to leaving. Similarly, when they believed that direct exposure to the fire front was the main cause of house ignition, they tended to retain last-minute evacuation as a viable approach to staying to defend. Flawed assumptions about bushfire hazards also underpinned the common misconception that passive sheltering constitutes an appropriate first line of response. Importantly, numerous studies of bushfire disasters have attributed a large proportion of fatalities to a general lack of knowledge about the specifics of bushfire hazards (McLennan *et al.* 2009; Handmer *et al.* 2010). Therefore, the physical characteristics of bushfire hazards should be made a core component of school-based bushfire education.

The influence of children's existing knowledge on the interpretation of new information and novel situations was further evidenced by the application of house-fire escape plans to the bushfire context. As demonstrated by children's detailed accounts of well-developed house-fire escape plans, school-based house-fire education has been highly successful in conveying the key concepts of house-fire safety. Given that children are far more likely to be killed or injured in a house fire than a bushfire (Australian Bureau of Statistics (ABS) 2005; Haynes *et al.* 2010*a*), it is essential that bushfire education does not undermine this success. This will require education programs that highlight the fundamental differences between house-fire and bushfire emergencies and explicitly dispel any notion that house-fire escape plans can be appropriately applied in the bushfire context. Ensuring that children understand the physical characteristics of bushfire hazards will likely assist this process.

The results suggest that the success of house-fire education has been partly due to homework activities that encourage households to develop house-fire escape plans. Although it has been suggested that a similar approach could be used to encourage household planning and preparedness for bushfire (Teague *et al.* 2010; AFAC 2014), there are some important caveats. Corroborating previous research (e.g. Finnis *et al.* 2010; Ronan *et al.* 2010), the children in the current study suggested that understanding their household bushfire plan had assuaged their bushfire-related fears. However, not all parents had sought to involve their children and some had made a conscious decision not to do so. Thus, home-based bushfire planning activity will need to be accompanied by evidence-based information on benefits of involving children, as well as practical advice on how to do this effectively (cf. Bushfire Cooperative Research Centre (CRC) 2013). For children who

might struggle to engage their parents, home-based activities will also need to include straightforward planning activities that children can carry out relatively independently, such as packing a firebox. Importantly, the psychosocial benefits of packing a firebox should not be underestimated: first, it would bolster children's sense of self-efficacy, which is a key predictor of future preparedness behaviours (Citizen Corps/Federal Emergency Management Agency (FEMA) 2008; Solberg *et al.* 2010); and second, in the event of an actual disaster, the protection of valued possessions would act as a buffer against the development of trauma symptomology (Woolsey and Bracy 2010; Osofsky and Osofsky 2013).

In the present research, the application of qualitative methods enabled the identification of clear trends in children's misconceptions. However, the identification of these trends should not be viewed as a substitute for bushfire education that facilitates genuine dialogue between children and educators. Bushfire education that advances children's knowledge will require learning activities that encourage each child to voice their perspectives and allow the idiosyncratic nature of their misconceptions to be understood. This precludes taking the misconceptions documented in this paper and presenting them to children as 'myths' to be 'debunked'. Such an approach would only circumvent the kind of dialogue that promotes knowledge development (Cole 1996; Rogoff 2003). As demonstrated by Rogoff *et al.* (1993), knowledge development requires a 'stretch' on the part of both children and educators: educators must stretch themselves 'downward' to understand how the child understands the task or problem, whereas the children must stretch themselves 'upward' in the direction of a more mature definition. Thus, opportunities for genuine dialogue should permeate every element of children's bushfire education.

Although this research has identified key issues that should be considered in the design and delivery of children's bushfire education, there is an urgent need for further research in this area. First, the aim of this research was theory development, which required the use of inductive research methods. However, the emergent theoretical insights should now be subjected to rigorous testing through the use of hypothetico-deductive methodologies and quantitative methods. Second, the results represent the knowledge and experiences of a discrete demographic cohort (i.e. predominantly white, English-speaking, 8- to 12-year-old children). Furthermore, although boys and girls were equally represented in the sample, the data were not analysed through a gendered lens. Yet personal characteristics such as age, gender, race, socioeconomic status, ethnicity and disability strongly influence how people experience hazards and disasters (Hewitt 1997; Wisner *et al.* 2004; Collins 2005; Eriksen *et al.* 2010; Whittaker *et al.* 2012). Therefore, this research should be extended to incorporate gendered analyses of both younger children and adolescents from a wider range of socioeconomic and cultural backgrounds.

There is also a need for policy research that more clearly defines children's roles in bushfire response. Although several families in this study had involved their children in plans to stay and defend, the official consensus is that children should be kept well away from any bushfire threat (CFA 2013). At the same time, fire agencies advise residents to decide what they will do if they cannot leave (AFAC 2012; CFA 2013). Yet there is no advice for how families with children should manage this contingency. Although the analysis of Black Saturday fatalities highlighted the dangers of leaving children unattended inside homes (Handmer *et al.* 2010; Teague *et al.* 2010), the actions that contributed to children's survival were not thoroughly examined. Further research in this area would enable evidence-based messaging and provide a more solid foundation for child-centred policy development.

Finally, a major limitation of this study is that neither teachers nor emergency managers were interviewed, thereby precluding an examination of the contextual factors that influence the development and delivery of school-based bushfire education. In the international literature, a general lack of hazards education in schools has been attributed to an overcrowded curriculum, an absence of quality teaching resources and a lack of knowledge and awareness among teachers (Shaw *et al.* 2011; Selby and Kagawa 2013). Yet none of these explanations have been substantiated by empirical research. If the most recent recommendation of the Victorian Bushfires Royal Commission is to be fully implemented, the contextual factors influencing the delivery of school-based bushfire education will need to identified and addressed.

Conclusion

Although Australian children have been marginalised and excluded from academic and political discussions of community bushfire safety, this research suggests that they should be afforded a more significant role. Although children's knowledge was often characterised by gaps and misconceptions, they also demonstrated a capacity for understanding the fundamental principles of safe emergency response, particularly when they had been involved in household bushfire planning. As such, children represent a major resource for the development of safer, more resilient communities. Although the increased commitment to delivering bushfire education in Australian schools represents a valuable opportunity to capitalise on this resource, education programs will need to accommodate children's existing knowledge as well as the social contexts of their everyday lives. This will require learning activities that facilitate genuine dialogue between children, parents and educators and respect the diverse perspectives and experiences of these various stakeholders.

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