



A theoretical framework explaining evacuation travel behaviour in bushfires: A qualitative study of destination and mode choices

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ABSTRACT

An understanding of how evacuees travel during bushfires remains limited, with existing research offering little consensus on the key influential factors. Additionally, bushfire studies often overlook key psychological and social (i.e., unobservable or latent) factors that may serve as mediators in evacuation travel decisions. Drawing on seminal theories commonly used in non-emergency transportation research, this study proposes a novel theoretical framework explaining destination and mode choices in bushfire evacuation, highlighting the role of observable and latent factors in the choices made. Qualitative data from 52 semi-structured interviews with fire survivors from three Australian locations, conducted between May and August 2024, have been analysed. Findings reveal new insights for bushfire evacuation literature, including the impact of attitudes (e.g., affordability, emotional support), familiarity, social connections (e.g., strength of ties), and perceived behavioural control on destination choices; as well as links between mode choices and perceived social responsibility, social connections, affect, and attitudinal factors of comfort, safety, and flexibility in travel. By addressing the omission of latent factors in current bushfire studies, this study enables the development of more comprehensive empirical models predicting bushfire evacuation travel behaviour, and in turn, improved evacuation simulation tools, community-wide evacuation plans, and real-time evacuation decision-making during fires.

1. Introduction

Bushfires are increasing in severity and frequency, driven by the effects of rising average temperatures, extended drought periods, and strong wind events – made worse by climate change – and the ongoing spread of residential development into areas bordering bushlands [1]. In many regions, evacuating early before fire conditions escalate is widely promoted as the safest protective action for populations threatened by wildfires [2,3].

However, evacuation from high-risk areas can be challenging for both rural communities [4] and more densely-populated areas located on the urban fringe [5], which are experiencing an increase in the rate of bushfires [6]. With these challenges in mind, it is therefore critical that high-risk communities plan for and anticipate evacuation issues in preparation for future fire events (likely to increase in severity and

scale). Evacuation simulation tools, for example, are available to help planners better prepare for bushfires [7–9]. They can be used to forecast travel times, average traffic speeds and flows, and potential congestion points, enabling officials to consider redundancy in routes and design traffic management measures. While these models have the potential to quantify evacuation performance and inform planner decisions, they are undermined by the absence of a comprehensive conceptual understanding of evacuee decision-making during bushfires.

While considerable progress has been made in understanding the initial decisions of whether to evacuate and even when to leave [8,10,11], subsequent travel-related choices for evacuees such as destination, mode, and routing choices remain less understood in bushfires. Thus far, the quantitative models predicting individual evacuation travel behaviour in disasters are typically discrete choice models which are based on a micro-economic utility-maximisation framework [12]. Utility

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approaches infer people's preferences from their intended (stated) or actual (revealed) behaviour, which are assumed to be determined by observable characteristics of the individual and choice alternatives, such as age, homeownership and destination proximity. However, with a few exceptions [13,14], these travel-related disaster models, especially in bushfire studies, often neglect to include latent factors [15], despite their demonstrated influence in studies of non-emergency travel behaviour [16,17]. Latent factors are unobservable, underlying features that are inferred from data, such as preferences or attitudes. This then begs the question, are we measuring the right things or asking the right questions in our studies of bushfire travel behaviour?

Hybrid choice models, for example, allow for the integration of latent psychological variables [18]; however, a higher-level conceptual theory of evacuation travel behaviour is needed before these quantitative models can be specified. Such a model would provide the basis for the development of quantitative predictions – enabling a credible set of influential factors and behavioural responses to be included, which are subsequently supported by quantitative data to determine the likelihood and impact of local actions.

The primary objective of this study is to develop a theoretical framework explaining destination and mode choices in bushfire evacuation, highlighting the role of both observable and latent factors in the choices made. This study addresses the omission of the less tangible (latent) factors in current empirical models which aim to quantify the impact of specific factors on evacuation travel behaviour in bushfires. Incorporating the influence of latent factors into evacuees' destination and mode choices enables more accurate predictions to be produced by simulation tools, assisting emergency planners to make more informed decisions when developing emergency and evacuation plans for future bushfires.

This article is organised as follows: Section 2 reviews the existing literature on evacuation travel behaviour, focusing on destination and mode choices. Section 3 then outlines the methodology of the study, followed by Section 4 which presents findings across three high-risk study areas in Australia that had been previously affected by bushfire incidents. Section 5 presents a discussion on the findings and study limitations, and Section 6 presents concluding remarks and future research directions.

2. Literature review

The first part of this literature review identifies the factors found to influence evacuation travel-related decisions, and in particular, destination and mode choices during bushfires and other hazards. This section concludes by highlighting the limited attention given to latent factors and discusses insights from theories commonly used in non-emergency travel behaviour research, which underscore the significance of these factors. While this review draws on evacuation behaviour across multiple hazards to compensate for limited bushfire-specific evidence, some factors may manifest differently in bushfires. In particular, bushfire-specific conditions (e.g., rapid fire spread; smoke, heat, and ember exposure; and infrastructure disruption) and the locations they often threaten (e.g., rural and peri-urban or wildland-urban interface areas) can differentially shape destination and mode preferences. Therefore, interpretations of findings from other hazards are made with this caveat in mind.

2.1. Destination choice in hazards

Beginning with the observable characteristics of the individual or household, a number of studies have found that socio-demographic factors influence destination choices in hazards. In hurricane and bushfire evacuations, higher income and education levels correlate with hotel stays or longer travel distances; while lower-income populations tend to travel shorter distances or rely on public shelters—which remain the least preferred option overall, used by only 5–15% of evacuees

[19–22]. Homeowners are less likely to prefer public shelters, and larger households or those with children often opt for hotels in hurricane evacuations [23]. In bushfire evacuations, older evacuees are more likely to travel farther to stay with family members [21].

Looking next to the observable characteristics of the destination choices, themselves: proximity, destination amenities or conditions, and elevation (in the case of tsunami) have been found to influence destination choices. During hurricane evacuations, evacuees initially aim for nearby destinations but often travel farther as shelters fill or storm tracks shift [24,25]. In tsunamis, evacuees prioritise elevation over proximity [26], while hurricane evacuees favour metropolitan areas with strong transportation links [25].

In fires and other hazards, studies have begun to explore the link between destination choices and the latent (i.e., less tangible) factor of perceptions of safety. Among bushfires, tsunamis and hurricanes, evacuees favour locations they view as physically and personally secure over the nearest option [14,27,28]; and tend to avoid public shelters perceived as structurally and personally unsafe, inconvenient and/or lacking privacy [14,29]. Tsunami evacuees also tend to travel to locations that feel safe based on prior knowledge of the area [28].

Only hurricanes and tsunami studies were found to have explored the role of a few additional latent factors in shaping destination choices. More specifically, hurricane and tsunami evacuees were found to prefer staying with friends or family over unfamiliar shelters, due to emotional support and cost savings [28,30,31]. Strong community ties correlate with evacuees choosing to stay in the homes of family or friends rather than public shelters in hurricane evacuations [19].

2.2. Mode choice in hazards

Observable factors are also predominantly explored in hazard-related mode choice studies. Socio-demographic characteristics of the individual and household, including age, gender, income, and home ownership have been found to influence evacuation mode choices. In hurricanes and tsunamis, younger evacuees are more likely to use cars than older evacuees, who may lack vehicle access and rely on carpooling, or evacuate from home rather than work [32,33]. In contrast, older evacuees in bushfires are more likely to use private vehicles [34]. Gender differences are also notable, with men showing a stronger preference for private vehicles, and women more likely to use public transport, particularly during tsunami evacuations [32,35]. In hurricane and bushfire evacuations, higher-income individuals and homeowners tend to use private vehicles or taxis, while lower-income groups and apartment dwellers, who typically have lower vehicle ownership rates, rely more on public transportation or carpooling [20,23,36].

Vehicle access and household composition, other observable factors of the household, consistently emerge as strong predictors of mode choice across bushfires and hurricanes [34,36,37]. Households with more adults or children often use multiple vehicles during bushfires [22,38]. Evacuees without private vehicles or with mobility limitations often depend on carpooling, public transportation and special evacuation buses in bushfires, hurricanes, and no-notice evacuations, especially in transit-dependent areas [34,36,39].

Other hazard studies identify additional observable factors, including the evacuees' location at the time of receiving an evacuation order. Hurricane and tsunami studies find that people at work are more likely to use cars than those at home [32,40]. Departure timing also plays a role in tsunami evacuations: late evacuees often opt for private vehicles, assuming they can reach safety faster [32].

Observable factors about the choices made, including destination type, travel distance, and traffic conditions are also influential. Walking is more common for shorter distances in tsunami evacuations, while car use increases as distance increases [26,28,32]. In hurricane evacuations, evacuees heading to hotels often use regular buses, while those going to public shelters more often use special evacuation buses; and those evacuating to friends' or relatives' homes frequently carpool, as these

destinations are often not served by organised transportation [36]. Traffic conditions at the time of departure also influence mode choice. During tsunami evacuations, severe congestion discourages car use during peak times, leading evacuees to walk or bike instead [41,42].

Tsunami studies, however, have explored unobservable factors including the role of habit and protective motivations in mode choices. Some evacuees choose cars out of habit, as was the case during the 2011 Tohoku tsunami [41]. Additionally, individuals also drive primarily to protect their vehicles from disaster-related damage in tsunamis [32].

2.3. Theories for evacuee travel behaviour

Taking an interdisciplinary approach over the years, the field of non-emergency transportation studies has applied a number of relevant theories that highlight the role of psycho-social factors in explaining travel behaviour [17,43–45]. The Theory of Planned Behaviour (TPB), one of the most frequently cited in transport literature, posits that behaviour is influenced by intentions to act, which are influenced by behavioural attitudes, subjective norms and perceived behavioural control regarding that behaviour [46]. The Theory of Interpersonal Behaviour [47] advanced the TPB by introducing the role of affect (i.e. emotions) and social constructs (i.e., social norms and roles) in predicting intentions, and the automatic performance of a behaviour, or habit also emphasised by Gärling et al. [48], as a direct influence of behaviour.

Ecological models like Social Cognitive Theory [49] have also been applied to explain non-emergency travel behaviour by integrating social and spatial environments among psycho-social factors, e.g., Refs. [50, 51]. The core concept of ecological models is that multiple levels of factors interact to influence behaviour [52]. At the centre of ecological models are individual factors (e.g., intrapersonal, biological and psychological factors) which are influenced by interpersonal factors associated with social norms and networks, followed by organisational and cultural characteristics, and finally community and societal factors, like policy. Relating this to disasters, the household is a key element of an individual's social environment; therefore, it is not surprising that household size and the presence of children are identified as key determinants of mode choice in bushfires [38,53]. Missing, however, from bushfire evacuation models is exploration into a community's social connectedness on travel behaviour, as an example. In this context, social connectedness is defined as the extent to which individuals feel that they have a sufficient number and quality of relationships that foster belonging, care, value, and support, and has been found as influential on an individual's disaster response, recovery and overall psychological resilience [54–56].

Therefore, this study examined how and why do bushfire evacuees make travel-related decisions during fires, including where to go and what mode to choose to get there, with a specific focus on the influence of latent factors on these decisions to develop a theoretical framework. The following section presents the study's design and locations, research methods, and participant details.

3. Methods

In this study, in-depth semi-structured interviews were used to understand evacuee travel behaviour in three locations in Australia (one in Victoria and two locations in Western Australia) that had recently experienced a bushfire. This study received ethics approval from RMIT University's Human Research Ethics Committee on 13/11/2023 (project ID: 2025-26141-28302).

3.1. Study design

Qualitative methods were selected for this study since the project's aim was to provide a conceptual understanding of the participants' travel-related decisions based on their experiences, perspectives, and

perceptions of the world around them, which could then underpin future quantitative data collection and modelling techniques [57]. By asking open-ended questions, participants could provide rich explanations of their thoughts during the fires and narratives explaining their reasons for making certain choices during evacuation. These data then allowed the research team to dive into the complexity and detail surrounding evacuation decision-making to discover emergent (e.g., latent) factors and begin to identify conceptual patterns.

3.2. Study locations

Three different locations in Australia were chosen for this study¹ – each of which had experienced a fire and were under some type of evacuation warning during the 2023–2024 fire season. The first study location is Pomonal, Victoria, which is a small rural township situated on the eastern edge of Grampians National Park, located roughly 245 km from Melbourne's central business district (CBD). According to the 2021 Census, the town has a population of 356 residents [58]. On the morning of the 13 February 2024, a day which was categorised as Catastrophic via Australia's fire danger rating system,² a dry lightning storm ignited a fire on the ridge above Pomonal. Around 1410, residents of Bellfield, Halls Gap, Lake Fyans, and Pomonal were issued an *Emergency Warning*³; and Forest Fire Management Victoria predicted that the fire would reach Pomonal within the next 2 h. By 1540, authorities stated that it was 'too late to leave' home, and that people should seek shelter immediately. Warnings for this fire were disseminated via multiple sources, including VicEmergency (the centralised website and mobile phone app for relaying emergency information and warnings in Victoria), social media, ABC radio, and SMS messages via mobile phone. The fire burned approximately 2223 ha of land across the park [59]. No lives were lost in Pomonal; however, 45 homes were destroyed [60].

The second study location is Parkerville, Western Australia (WA), which is a suburb of Perth, located approximately 30 km from Perth's CBD. The suburb was reported to have a population of 2432 people in 2021 [58]. The Parkerville fire ignited on Thursday, 21 December 2023 and was first reported at 0930 that day. By 1011, the Department of Fire and Emergency Services (DFES) in WA sent out an *Emergency Warning* for certain areas of the Parkerville suburb. This warning was updated at 1120 with a 'too late to leave' message [61]. By around 1749, the fire had been contained and DFES downgraded the highest warning level to *Watch and Act* [62]. The 2023 Parkerville fire destroyed two homes and injured two people [63]. The fire is estimated to have burnt 90 ha of land [64].

The third study location is the City of Wanneroo, also in WA. The City of Wanneroo encompasses 36 suburbs [65]. The Australian Bureau of Statistics' estimated population in 2021 was 209,111 [58]. The Wanneroo fire (also known as the Mariginiup fire), began on Wednesday, 22 November 2023, originating in Mariginiup, one of the suburbs within the City [62]. The fire was reported at 1309, and by 1400, an official *Watch & Act* warning had been issued for the suburbs of Mariginiup and Jandabup. In the following days, the fire continued to burn, with nearby suburbs such as Tapping and Sinagra, falling under various warning levels, including Emergency Warnings. On Sunday, 26 November 2023, DFES confirmed that the fire had been controlled and contained [66]. The 2023 Wanneroo bushfire burnt across 1900 ha and destroyed 18 homes and 15 commercial properties [65]. In both fires in WA, warnings

¹ It is important to note that since Australian bushfire policy does not require mandatory evacuation, the term "evacuation" used throughout this article is synonymous with "self-evacuation" when referring to the behaviour of study participants during their bushfire experiences.

² Information on the Australian Fire Danger Rating System can be found at the following link: <https://afdrs.com.au/>.

³ Information on the Australian Warning System can be found at the following link: <https://www.australianwarningsystem.com.au/>.

were also disseminated via multiple channels, including Emergency WA (the centralised website for relaying emergency information and warnings in WA), SMS messages via mobile phone, Bushfire.io (a third-party, national disaster mapping platform), social media, and ABC radio.

3.3. Recruitment

Recruitment materials were co-designed with local councils and fire agencies, and disseminated via local media (radio and local newsletters), relevant social media groups, social media posts from local council and fire agencies, letter drops, and posters. Screening questions for this study included the following: (1) Did you evacuate as a result of the [NAME] bushfire in [LOCATION]? and (2) Are you 18 years or older? If the participant was over 18 years old, they could opt to use an online booking system or request that a team member contact them to book their interview. In each of the three study locations, researchers aimed to recruit 30-35 people (including both residents who evacuated and residents who did not evacuate). While the researchers met this goal, on average, across the three locations, the participants included in this study are only those who evacuated during the fire event.

3.4. Data collection

The interviews for this study were conducted between May and August 2024 and were, on average, approximately 1-h in length. Most interviews were conducted in person, with ~10% conducted online, via Microsoft Teams. All participants received a \$30 gift card as a token of appreciation for their involvement. At the start of each interview, participants were asked for their consent to be audio recorded to ensure accurate data capture, to which all agreed. Prior to beginning the interview, participants were also asked to complete a brief questionnaire to gather background information. Adopting a participant-led and trauma-informed approach, the interview team encouraged residents to share their personal fire experiences in their own words in a comfortable environment. Following the interview guide, participants were first asked to walk through their experiences of the fire, uninterrupted. Next, interviewers asked follow-up questions about participants' bushfire preparedness; their evacuation-related decisions during the fire (i.e., whether they evacuated and why); their travel behaviour and why it was chosen (for evacuees and non-evacuees) including where they traveled and how they got there; what information they received during the event; and how and when they returned home. A copy of the interview questions is included in [Appendix 1](#).

3.5. Participants

A total of 52 evacuees were interviewed for this study, including 17 from Location 1 (Pomonal), 18 from Location 2 (Parkerville), and 17 from Location 3 (Wanneroo). Most interviews were conducted one-on-one. In a few households, two members were interviewed together, or separately when their experiences differed. Where household members described similar destinations and mode choices, their accounts were combined in the analysis to prevent redundancy and avoid overstating certain themes.

The most common age group among participants was 45–54 years (27%), with 29% in age groups younger than 45 years and 44% in age groups older than 54 years. The most common education levels were TAFE qualifications (30%) and postgraduate degrees (30%), followed by Bachelor degree (26%). Just under half of the participants were employed or self-employed for more than 18 h per week. In Location 1, one-third of participants were retired—three times the proportion observed in Location 2, and none of the participants from Location 3 were retired. The majority of participants across all locations were fully insured for their house (73%), contents (71%), and vehicle (83%). Also, related to previous experience with fires, only 18% of participants had experienced more than five bushfires. Regarding evacuation history,

38% had evacuated once due to a bushfire, and 27% had evacuated two or more times. Participants from Locations 1 and 2 were more likely to have made modifications to their homes to protect against bushfires (~75%) when compared to those in Location 3 (~13%).

3.6. Data analysis

After the interviews, all audio recordings were transcribed and coded using NVivo [67]. Data analysis broadly followed the “Framework” method for classifying and organising qualitative data into themes, concepts, and categories [68]. First, a set of codes were initially developed based on the topics covered by the interview guide. After reviewing the transcripts, these codes were revised to account for additional topics mentioned by participants. To ensure intercoder reliability, recommendations by Coffie et al. [66] were strictly followed: multiple researchers (four) coded the transcripts (two of whom were not involved in data collection), three coders had experience in qualitative methods, the four researchers coded data from all three locations, a shared codebook was created via an iterative process, and multiple team meetings were held to finalise the codes.

Regular team meetings and check-ins were maintained throughout the analysis in case any updates to the codebook were required. Once the data were coded for all participants, only the coded transcripts of evacuees were considered for this study since we focused on evacuee travel behaviour. A spreadsheet was developed whereby quotes and researchers' detailed observations were extracted from the coded transcripts to better organise the data and allow for comparison of findings across different groups within specific codes/columns. The first version of this spreadsheet stayed as close to the original transcripts as possible, to maintain participant narratives and quotes. Subsequent versions of the spreadsheet were developed to identify and categorise the experiences and factors that influenced participants' travel behaviours. These categories were organised into the themes presented in Section 4, which include unobservable and observable factors for both destination and mode choices. Unobservable factors were further grouped into attitudes, social norms and networks, perceived behavioural control, habit, affect, and constraints. Observable factors were categorised into individual, household, and choice-related characteristics.

A factor was considered influential when: (1) participants explicitly identified it as shaping their evacuation choices during the interview, and/or (2) consistent patterns in travel behaviour were observed across demographic groups. Although this study was exploratory and all factors mentioned by participants were documented, each factor was raised by multiple participants across different locations. This recurrence strengthened their inclusion in the conceptual framework.

Each of these factors will be described further in Section 4. This article also includes archetypal quotes from participants that support and help to illustrate these themes.

4. Findings

In this study participants reported a number of factors as influential on their destination and mode choices during evacuation. As shown in [Table 1](#), these factors are organised by three categories: unobservable or latent factors (i.e., attitudes, social norms/networks, perceived behavioural control, habit, affect, and constraints), as well as observable factors of the individual, household, and the choice. The mode choice column in [Table 1](#) presents the factors that influenced the choice (i.e., primarily to evacuate via private vehicle) as well as the number of vehicles selected for evacuation (single vs multiple vehicles). The findings for destination and mode choices are discussed in the following sections.

4.1. Destination choices and influential factors

There were a number of reasons that participants gave for choosing their destinations, which were primarily to friends' and family's houses,

Table 1

The factors found in this study to be influential in bushfire evacuation destination and mode choices organised by latent and observable factors. A ^(C) refers to those factors that influence the choice of mode type, while all other factors in that column influence the number of modes selected. A (TD) refers to those factors that influenced gathering at temporary destinations or mustering points before traveling to a later destination.

Factor category	Factor sub-category	Destination choice (including temporary) – influential factors	Mode choice ^C (and number of vehicles) – influential factors
Latent or unobservable factors	Attitudes	<ul style="list-style-type: none"> • Comfort (for kids/pets) • Supportive environment • Safety (away from fire) • Affordable • Fun/enjoyable (TD) 	<ul style="list-style-type: none"> • Safety^C • Comfort (for driver/passengers; pets) • Flexibility/freedom in travel
	Social norms/networks	<ul style="list-style-type: none"> • Loved ones offered, booked it, or were located there • Social connections (within or outside of the community) 	<ul style="list-style-type: none"> • Responsibility for the vehicle^C • Social connections with the community (offered a ride)^C • Felt capable of driving alone (multiple vehicles)
	Perceived behavioural control	<ul style="list-style-type: none"> • Available for timeline needed • Accessible 	N/A
	Habit	<ul style="list-style-type: none"> • Familiar place/space 	<ul style="list-style-type: none"> • Positive attachment to vehicle^C
	Affect	<ul style="list-style-type: none"> • Aesthetics (TD) 	<ul style="list-style-type: none"> • Negative/nervous feeling if evacuate alone (one vehicle) • Only one vehicle or driver available
Individual/household observable factors	Contextual factors/constraints	<ul style="list-style-type: none"> • Lack of social connections/did not know anyone else • Negative perceptions of alternatives (e.g., relief centres or places that would not take pets) 	<ul style="list-style-type: none"> • Vehicle access^C • Household make-up: <ul style="list-style-type: none"> ○ Disabilities^C ○ Number of evacuees/children ○ Gender ○ Size and type of pet(s) • Insurance status of the vehicle^C • Larger space (inside)^C
	Choice observable factors	<ul style="list-style-type: none"> • Household make-up <ul style="list-style-type: none"> ○ Children ○ Pets • Larger space (indoors or outdoors) • Amenities: cooling or shade, food and drink (TD) • Closer proximity to home • Views of the fire (TD) 	

with a few traveling to motels/hotels or evacuation relief centres. First, classified under the latent constructs of attitudes and habit, destinations were chosen because they offered a comfortable place to stay that put them at ease; i.e., describing their selected destinations as supportive, welcoming, familiar and/or offering sufficient room or space for themselves, their kids and/or their pets. A resident from Location 1 expressed relief when a friend texted them to come and stay:

“[a friend] texted me and said, ‘... you are more than welcome to come and stay with us ... We’ve got a big house. There’s a whole spare room. You’re welcome to bring the dogs into the room’; because they have indoor dogs, too; which again not everyone kind of understands. So that was a relief.” (Pomonal [Po] 18)

At their mother-in-law's house, for example, a participant from Location 3 noted that: *“there is room; there is beds; there is hospitality ...”* (Wannero [Wa] 8). Also, highlighting the importance of familiarity, a resident from Location 2 explained that their destination was:

“... good for the kids; because we were with the grandma. I mean, they have got me; but it was an area that was familiar. If we had to leave to come back and do something, the kids could stay there. So it just made sense to go to another family member’s house.” (Parkerville [Pa] 13)

Additionally, residents chose their destinations based on their perceived safety. Destinations were often perceived as safe if they were unlikely to be exposed to fire or if the destination was already part of their pre-fire planning.

Within the category of perceived behavioral control, participants also favoured destinations with hosts (friends/family) who could accommodate their stay for as long as they needed. This was especially comforting for participants (e.g., in Location 1) who later found out that they had lost their homes. One participant recalled that: *“[Friends] rang us and said, ‘The house is empty. Come and stay’”* (Po13). In some cases, residents who lost their homes had to stay at multiple destinations before finding something more permanent (including caravans on their properties). On the other hand, the majority of Location 2 participants spent only 2-10 h at their destinations and then returned home later that

afternoon or evening when they perceived the fire to be ‘under control’. In Location 3, most participants evacuated for 1-3 nights – and often returned once their home was no longer in an emergency warning area.

Social networks also played a role in destination choices, not only offering their place when residents were in need, but also booking accommodation for participants, especially in cases when they needed extra support. One resident with a visual disability recalled their destination choice: *“Because that’s where they booked me in ... it was a very combined effort. I have got my aged care package, and my case manager, she made the booking”* (B11).

More specifically, for Location 1, where some residents selected rental properties, the attitudinal factor of affordability of the destination was considered. Another reason given for destination choice in Location 2 was its close proximity to home (should they need to go back for any reason). Additionally, in Location 3, residents mentioned that they chose their destination because of their social networks and constraints within these networks. In some cases, residents felt that they had no other choice (i.e., it was the only person that they knew) in the area. In one participant's case, their mother-in-law was: *“all we’ve got here. I don’t have family here. My family are from Melbourne”* (Wa1). Similarly, another resident explained that they went to their friend's house:

“Only because they had rung me - well, we moved from Melbourne five years ago. So we don’t know people here. So we had nowhere else to go. Like, that was it. And they were - they are relatively close.” (Wa5)

Noting other constraints, a few participants in Locations 1 and 3 specifically mentioned that they did not want to stay at the evacuation (or relief) centre, if they could help it. An older couple, for example, was concerned that the centre wouldn't be a comfortable place to sleep and a few were unsure of its location. Others were concerned about their pets' well-being or the lack of amenities:

“... it’s a great service; but I think that you have to sign in; and then you can’t leave; and that there’s no real resources; and it is hot and it is crowded; and the kids have nothing to do. It is very, uh, - yes, it is just not

- if you have an alternative to go there, then I would take the alternative.” (Pa18)

Prior to reaching their overnight destinations, however, many participants across the three locations temporarily stopped at public places located in nearby towns outside of fire-affected areas. These locations often served as temporary destinations or mustering points for residents as they sought additional information, assessed their risk and decided upon next steps. While these stops could be classified as intermediate trips, they often functioned more like temporary destinations, especially for those participants who were uncertain about where to go, unaware of the location of relief centres, or had chosen to adopt a wait-and-see approach in the hope of returning home early – thereby potentially avoiding the need for an overnight stay.

These temporary destinations included public libraries, parks or camping spots, community or neighbourhood houses, local pubs, and shops. In turn, they provided opportunities for evacuees to gather and meet with other people (i.e., friends, family and neighbours), mill and decide on next steps, facilitate fun and play time (for children and pets), drop off or transfer pets, physically monitor the fire's location or progression, and gather or shop for supplies.

Participants, particularly in Locations 1 and 2, favoured mustering points that were accessible, large open spaces with access to amenities, such as cooling or shade. Participants also mentioned that they were drawn by aesthetics. A Location 1 resident explained that:

“Nearly all the people from Pomonal who left, we all turned up at Cato Park (laughs). So just near the Stawell Neighbourhood House, there's a beautiful park and a lake; and we all rocked up there.” (Po7)

These participants gathered in similar places because of their social networks. They either knew that their friends/neighbours were going there or these were familiar places where their social networks usually gathered. For example, a Location 2 participant reportedly chose their mustering point because that location (the pub) was the “... centre of our community ... that's where people congregate and that's where you hear the news” (Pa17). To many, comfort was also a factor in that the pub was a comfortable place to bring pets, especially among individuals who felt that options catering to pets' needs were limited. In some cases, these open spaces also provided a strategic vantage point for safely observing the fire's progression, or access to emergency responders who would often establish command centres in close proximity (Pa8).

While only a minority of Location 3 respondents gathered at mustering points; those who did traveled there to meet a few others, regroup, and/or figure out next steps, as well as in some cases, pick up food for dinner or monitor the fire (from a safe distance away). One resident explained:

“Just so that we could gather our thoughts and figure out, ‘Okay, where's the next best place to go?’ We had in our heads a rough idea where we were to go. So the original plan was: we were going to go to my sister's place, along with my parents; and stay there.” (Wa11)

4.2. Mode choices and influential factors

Regarding mode choices, residents in all three locations preferred private vehicles and when more than one driver and vehicle were available, most evacuated with multiple private vehicles. When selecting their transportation mode(s), access to a vehicle in the first place was paramount. Additionally, participants also considered the following when selecting their mode (each categorised as latent factors): the perceived safety provided by the vehicle and their responsibility for and/or attachment to the vehicle(s), which was also linked to whether the vehicle was insured (or the expense that might be incurred if left behind). For example, a participant in Location 2 felt an added responsibility to take their work vehicle with them when evacuating (Pa11). Additionally, a few participants in Location 1 indicated a

reliance on their social networks, including their spouse and close friends, for transportation. This dependency was primarily shaped by physical disabilities that inhibited their ability to drive, highlighting the role of interpersonal support systems in navigating mobility constraints.

Other factors were identified that influenced whether participants evacuated with multiple vehicles. In addition to access to multiple vehicles, other factors included the amount of space/room that they needed for evacuation – i.e., space for valuables, dependents, and pets, which influenced the level of comfort experienced by the driver and passengers. Participants also felt that separate transport modes provided flexibility in travel both during and after evacuation. For this participant in Location 3, multiple vehicles provided sufficient room for everything and everyone and flexibility in travel while staying at the destination:

“We could not have fit two suitcases in my car; and the four of us, plus the dog. And we didn't want to leave the car behind ... and also because my daughter is in her early 20s; it is hers. And it would have meant that she would have been dependent on us; so, yep; and so she could go to work.” (Wa16)

In a few instances, household members left for their destinations at different times. This finding was primarily gendered, with male members tending to delay their departure longer than women and younger children. Staying behind allowed them to prepare the house, help others prepare, or even attempt to seek additional information before leaving themselves.

Additionally, especially in Locations 1 and 3, participants evacuated with multiple vehicles to save them from potential fire damage due to their perceived responsibility for these vehicles. In Location 2, however, where participants were closer to nearby towns, some residents elected to drive their vehicles out and then return via rides from loved ones to continue packing.

In only a few instances (from Locations 1 and 3), couples evacuated in one car so that they could remain together. From their perspectives, evacuating separately introduced unnecessary feelings of anxiety in an already stressful situation. For example, one couple explained:

“... because I have heard - a lot of things that were helpful were previous stories of fires and people taking separate cars; and not knowing if each other was okay and that sort of thing. But also not just this area fires, but all those bush - major horror, horrific fires in Melbourne and everywhere over the years; just media and all that stuff, you think back to that. You think back to some of the things you heard that went wrong and why.” (Po21)

5. Discussion

The aim of this study was to create a theoretical framework, shown in Fig. 1, explaining destination and mode choices during bushfire evacuation. The observable and latent factors presented in Fig. 1 comprise those from the hazards literature (Section 2 of this article) and those identified from this study. The findings of this study that align with prior bushfire and no-notice event studies are labeled with an asterisk (*) and those that align with hurricane, flood, or tsunami studies with a double asterisk (**) in Fig. 1. Also in Fig. 1, those factors labeled with ^(L) were found as influential only in previous hazards literature, but not in this study, and those with no label are novel insights from this study for the hazards field.

Regarding the observable factors of the individual and household, this study found that transport modes were selected based on vehicle access and both mode and destination decisions were influenced by household make-up, including the number of evacuees and the needs of people with disabilities, which align with previous bushfire literature [20,34]. However, counter to bushfire [20,21,34] and hazards [23,36] literature, this study did not find trends linking age, education, income, home ownership, initial location, or departure timing directly with transport decisions. While our novel framework requires validation by

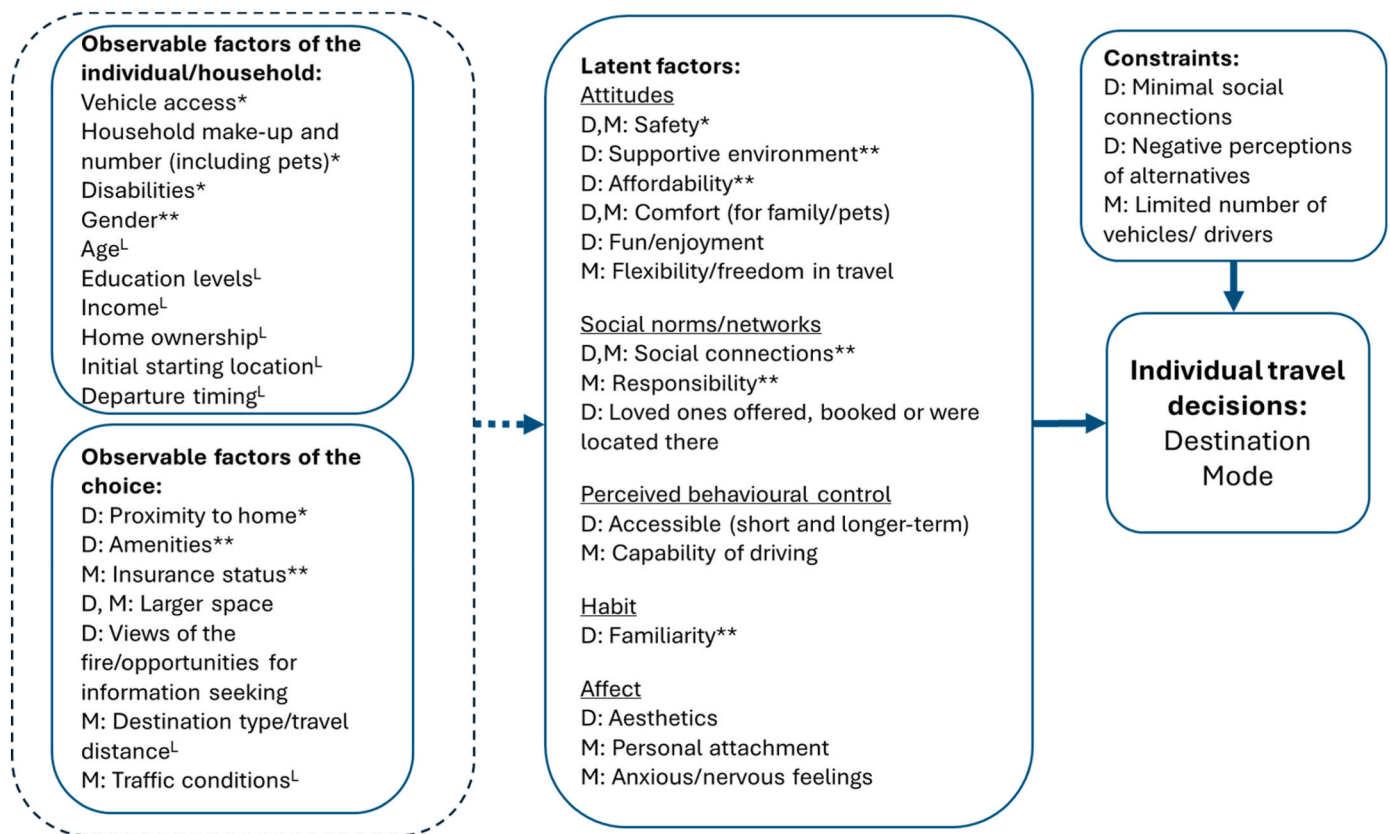


Fig. 1. Theoretical framework identifying the factors of influence for destination choice and mode choice in bushfire evacuation. An (*) refers to this study's findings that align with prior bushfire and no-notice event studies, (**) refers to findings that align with prior hurricane, flood, or tsunami studies, and (L) refers to findings only from previous literature. The dashed arrow indicates that these relationships are conceptual and require quantification in future empirical work. Also, "D" refers to destination and "M" to mode when referring to the observable and latent factors associated with the choice, itself.

future quantitative studies, it is suspected and therefore depicted in Fig. 1 that these variables, especially demographics, more often influence mediator variables, like perceptions, attitudes and social connections, which then link to travel-related decisions, as is the case in non-emergency transport studies [69]. As an example, we found that gender influenced mode choice, similar to Ref. [32], however, it was primarily linked with the perception of flexibility in travel, which then influenced the choice of taking multiple vehicles.

For the observable factors of the choice, our study found that most evacuees preferred destinations that were closer to their home (where possible) with favourable amenities, which aligns with previous bushfire and tsunami studies [25,70], and mode choice was linked with insurance status of the vehicle, as was found in studies of tsunami [32]. Novel to the hazards literature; however, was the impact of larger space (both within the mode and destination) and the provision of opportunities for information seeking as influential to transport choices. Additionally, counter to hurricane and tsunami studies [28,36,42], this study did not find links between destination type, travel distance, or traffic conditions and transport decisions. This is likely due to the lack of variance in transport choices by participants in our study. While these results are reasonable for our selected case studies (as documented in the limitations for this study), additional exploration of these factors is required in future studies.

Finally, as shown in Fig. 1, our study provided important insights into the role of latent factors on destination and mode choices. Aligned with previous bushfire literature, is the influence of perceptions of safety on destination choices [29,70,71]. Our study also found that emotional support, affordability, stronger social connections, and familiarity influenced destination choices and social responsibility was linked with mode choice, which confirm results found in tsunami and hurricane

studies [19,28,30–32] but present novel findings for the bushfire field. Additionally, new to the hazards literature is the critical role of comfort in destination and mode selection. For destinations more specifically, this finding emphasises both the physical dimensions of the space and the emotional support and sense of familiarity it provided for family members and their pets [72–74]. This study also introduced the influence of enjoyment, accessibility and aesthetics on destination choices and flexibility in travel, capability, personal attachment, and negative feelings of anxiety on mode selection. Also important were the constraints on these choices prompted by limited social connections, negative perceptions about choice alternatives, and limited numbers of drivers or vehicles.

This study establishes the underlying factors that form the foundations of a theoretical model for bushfire travel, which is necessary before large-scale data collection focusing on quantifying the impact of specific factors on performance can be conducted. In this field, there is a temptation to jump into such analysis early, especially given evolving capabilities in big data and machine learning techniques. However, independent of the event model being developed (whether via traditional or AI methods), a framework of the factors that influence performance is required. In turn, this novel theoretical framework supports the development of future quantitative models – providing a robust logical framework with which empirical evidence can be coupled in order to make more relevant and accurate evacuation predictions.

As with all studies, it is important to identify limitations. First, this study focuses on locations in Australia. It is acknowledged that evacuation policies can differ across countries; and given the complex interactions of cultural factors and safety practices, it is possible that evacuation travel behaviour may differ across countries. Additionally, this study focused on three communities in two states in Australia,

within which the evacuation policies of its eight states and major territories may differ. By selecting communities that differed in land-use type and community experiences, the authors aimed to reduce the impact of these limitations, where possible.

Additionally, the travel-related choices of the study's participants were similar across the sample; i.e., most participants selected to travel to friends'/family's homes via personal vehicles. However, these findings on destination type [22,30,70,75] and mode choice [22,34,76] are supported by previous bushfire and hurricane research. Also, these choices are feasible for the three studied communities; in that evacuation relief centres in Australia are not always structured to provide overnight services for evacuees and there were limited availability of public transportation and ride-sharing services in two of the three case study communities.

Although this study identified familiarity as an influential factor shaping evacuation mode and destination choices, this research was unable to fully examine the specific role of previous bushfire or evacuation experience. Not all participants had prior evacuation experience, particularly experiences involving concrete travel decisions, which limited our ability to draw direct associations between past evacuation behaviour and the choices made during the three recent fires. Similarly, while some residents discussed aspects of pre-fire planning, only a minority had a developed plan that specified destinations or travel modes, preventing a systematic analysis of how closely residents adhered to their plans. Future research should investigate these issues in greater depth.

Finally, as is common in qualitative research, the number of people interviewed within each community was limited. Additionally, the sample exhibited a slight age bias, with 68% of the sample 45 yrs or older. Despite the relatively small sample size and potential biases, the study successfully achieved its objective of identifying a broad range of factors influencing evacuation travel behaviour. This outcome is supported by the alignment of our findings with established behavioural theories commonly applied in non-emergency transport research.

6. Conclusion

This article develops a novel theoretical framework explaining the observable and latent factors that can influence destination and mode choices during bushfire evacuation from three communities in Australia. Findings from this study demonstrate the importance of latent factors such as attitudes, social norms and networks, perceived behavioural control, habit, and affect on travel behaviour during bushfires; in turn, confirming the applicability of relevant theoretical frameworks often used in non-emergency transport studies to the bushfire field.

Future research should empirically test this conceptual model using quantitative approaches, such as surveys designed to gather data on both latent factors and observable factors (e.g., individual and household characteristics, choice amenities, and route conditions), along with stated or revealed evacuation preferences. Researchers could then apply latent variable modelling techniques to evaluate the significance and magnitude of the underlying constructs, as well as their importance relative to the observable factors, in shaping mode and destination choices.

The empirical insights generated through this process would support the development of predictive models of bushfire evacuation behaviour. Ultimately, this work will improve evacuation simulation tools, inform community-wide pre-fire evacuation planning, and support real-time decision-making during bushfire events.

CRediT authorship contribution statement

Erica D. Kuligowski: Writing – review & editing, Writing – original draft, Supervision, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Rosie Morrison:** Writing – review & editing, Writing

– original draft, Software, Methodology, Investigation, Formal analysis, Data curation. **Steve Gwynne:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Gulsah Atas:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis. **Ruggiero Lovreglio:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Fatemeh Roohafza:** Writing – review & editing, Software, Methodology, Formal analysis.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used Copilot and NotebookLM in order to slightly revise the language in a few places in the article to assist with readability. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Erica Kuligowski reports financial support was provided by Australian Research Council. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.firesaf.2026.104782>.

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