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Driving through floodwater: Exploring driver decisions through the lived experience

Permalink
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Publication Date
2019-03-01

DOI
10.1016/j.ijdrr.2018.12.019

Peer reviewed

Running head: Avoid driving through floodwater

Title: Drivers' experiences during floods: investigating the psychological influences underpinning decisions to avoid driving through floodwater

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Abstract

A major risk factor for many flood-related drownings is driving through floodwater. We aimed to understand Australian drivers' experiences and beliefs with respect to avoid driving through floodwater using the theory of planned behaviour as a framework. Study 1 (*N*=23) used a qualitative design to gain an in-depth understanding of individuals' experiences with driving through floodwater. Study 2 (*N*=157) used a survey-based design to identify the factors related to this behaviour including knowledge, beliefs, and social-cognitive factors. In Study 1, drivers identified a range of advantages (e.g., didn't damage car), disadvantages (e.g., inconvenient, but not so terrible), barriers (e.g., urgency to reach destination), and facilitators (e.g., making plans and using existing plans) to avoiding driving through floodwater. Normative factors were also important influences on drivers' decisions including normative expectancy, approval of significant others, and a moral obligation for the safety of others. In Study 2, participants were able to recall information about driving through floodwater (e.g., dangerous/risky) and its meaning (e.g., body of water over road). A range of experiences were described for avoiding driving through floodwater (e.g., took an alternative route). Across the studies, a range of behavioural, normative, and control beliefs were elicited. Finally, sex (women more likely), attitude, subjective norm, and perceived behavioural control significantly predicted intentions to avoid driving through floodwater, with the model explaining 55% of the variance. These findings can inform intervention targets and development of prevention strategies for effective behaviour change, saving lives otherwise lost to Australian waterways in flood.

1 Introduction

Drowning is the third leading cause of injury-related deaths worldwide (WHO, 2014). Risk of drowning increases with floods and activities such as driving through, walking near, or playing in floodwater are commonly reported as preceding drowning (WHO, 2014). In Australia, reports have shown that around 53% of flood-related deaths, and 55% of all river flood-related unintentional fatal deaths (Peden, Franklin, Leggat, & Aitken, 2017a), were the result of driving through floodwaters. The use of personal vehicles, predominantly cars, to navigate flooded roads, have been identified as a precursor of flood-related drownings in Australia (Australian Water Safety Council, 2016; WHO, 2014). These drowning fatality statistics likely underestimate of the true extent of drownings caused by driving through floodwaters due to limitations around International Classification of Diseases (ICD) drowning codes (Peden, Franklin & Leggat, 2016a; Peden et al., 2017b). Despite mass media campaigns aimed at reducing driving through floodwaters (e.g., 'Turn Around Don't Drown', NOAA, 2004; 'If it's flooded, forget it', Queensland Governemnt, 2017), fatal and non-fatal incidents continue to occur regularly, resulting in a national call for research into behaviours around floodwater: "Therefore, strategies that encourage appropriate response among the community before entering floodwaters are of vital importance" (Australian Water Safety Council, 2016, p35).

It is widely assumed that people choose to enter floodwater because of a lack of knowledge around the dangers associated with driving through water (Franklin, King, Aitken, & Leggat, 2014). However, given the increased attention that the issue of driving through floodwater has received in both media coverage and public health messages, the dangers are known to many Australians (Hamilton, Peden, Keech, & Hagger, 2016a). Research has shown that people can recall and understand the risks of driving through floodwaters (Hamilton et al., 2016a; Taylor, Archer, Bird & Paton, 2016); yet, drivers continue to ignore safety warnings and carry out the behaviour (Shevellar & Riggs, 2015). A relationship has been identified between how severe drivers perceive the flooded situation to be and their reported likelihood to drive through a flooded scenario (Drobot, Benight &

Gruntfest, 2007). Even though drivers commended safety campaigns and messages, some drivers perceive them as not relevant to their own circumstances, believing their specific situation to be different from those in the warnings (Hamilton et al., 2016a; Shevellar & Riggs, 2015). This highlights that having the correct information does not always translate into behaviour change (Paton, Kelly, Burgelt & Doherty, 2006; Sheveller & Riggs, 2015), suggesting that the behavioural decision making in vehicles around floodwater is based on more than knowledge acquisition alone (Gissing, Haynes, Coates & Keys, 2016; Taylor et al., 2016).

Recent research has provided emerging evidence for the psychological factors that influence individuals' decisions to drive through floodwater (Hamilton, Peden, Pearson & Hagger, 2016b; Pearson & Hamilton, 2014; Taylor et al., 2016), including past experience, attitudes, social pressure, self-efficacy beliefs, and risk perceptions. Regarding the latter, the severity of the risk has been shown to have an effect on drivers' willingness to enter floodwater, but not the susceptibility of the risk (Pearson & Hamilton, 2014). Pearson and Hamilton explained that drivers may recognise the risk but fail to relate it to themselves, indicating an 'optimism bias'. Similarly, Taylor et al. (2016) found that merely understanding the risk and associated consequences does little to change individuals' behaviour when faced with a flooded path.

While existing research on individuals' decision making when driving through floodwater is relatively sparse, there is research that suggests performing and not performing a given behaviour are not conceptual opposites, and that different motivational pathways may operate in guiding individuals' decisions to engage in an action or behaviour and decisions to desist or avoid one (Middlestadt, Macy, & Geshnizjani, 2014; Richetin, Conner, & Perugini, 2011). This proposition that action and inaction behaviours are not determined by the same factors supports the need for research directed to understand both the desired behaviour (intentionally avoiding driving through floodwater) and the risky behaviour (intentionally driving through floodwater). Results of a study on intended bushfire actions of South-East Australians demonstrated the importance of making this distinction by identifying that the motives of those who intended to stay and defend their property

were different from those who took the recommended safe action of evacuating (McLennan, Paton, & Beatson, 2015). While the existing research provides some indication of the authentic experiences and influences of driving through floodwater, little attention has been given to situations where people intentionally decide not to drive through floodwater. It is proposed that the psychological factors underpinning this alternate decision could be distinct from those that influence drivers to enter floodwater. The current research aimed to examine the psychological factors that determine avoiding driving through floodwater, a behaviour that has not been examined previously and is important in order to gain a comprehensive understanding of drivers' decision making when floodwaters are encountered.

1.1 The Theoretical Framework

We adopted the theory of planned behaviour (TPB; Ajzen, 1991) to guide the current research. The TPB is a prominent social-cognitive theory that has been applied to understand social and health behaviour, and is supported by meta-analytic studies (e.g., McEachan, Conner, Taylor, & Lawton, 2011). A key hypothesis of the theory is intention as the proximal predictor of behaviour, with intention predicted by attitude (overall evaluations of the behaviour), subjective norm (perceived social pressure to perform the behaviour), and perceived behavioural control (perceived capacity to carry out the behaviour), with perceived behavioural control further hypothesized to predict behaviour directly. Past behaviour is often included as an additional predictor in the TPB.

Elements of the model have been applied to flooding preparation through highlighting the importance of norm-based influences on home owners investing in flood protection measures (Bichard & Thurairajah, 2014). More specifically, the model has helped to understand the social-cognitive factors associated with dangerous driving at a more general level (Parker, Manstead, Stradling, Reason, & Baxter, 1992) and to more specific driving violations such as speeding and overtaking (Forward, 2009), texting while driving (Nemme & White, 2010), and driving through floodwater (Pearson & Hamilton, 2014). Research on the latter behaviour suggests that driving through floodwater is a behaviour that is likely to be a rational, deliberative action and supports the

use of the TPB to better understand individuals' decision making in this context.

According to the TPB, the attitude, subjective norm, and perceived behavioural control constructs are global measures that summarise sets of personal, social, and volitional beliefs, referred to as behavioural (advantages/disadvantages), normative (social approval/disapproval), and control (inhibitors/motivators) beliefs, respectively (Ajzen, 1991). Belief elicitation is a suggested strength of the TPB (Ajzen, 2015); however, extant literature seldom includes the valuable, but time consuming, formative process of salient belief elicitation (Ajzen, 2015; Chan et al., 2015). These beliefs are important to behaviour change as they are often targeted in behavioural interventions based on the theory (Fishbein & Ajzen, 1975). Formative research on beliefs is therefore necessary for depth of understanding of the behaviour in a given population as well as to test the efficacy of the TPB mechanisms in changing behaviour (Ajzen, 2015; Epton et al., 2015).

A number of studies have used the belief-based aspect of the TPB to gain a detailed understanding of human behaviour. For example, studies adopting qualitative and/or belief elicitation methods using the TPB as a framework have broadened the understanding of physical activity (Hamilton & White, 2010), healthy eating (Sheats & Middlestadt, 2013), complying with speed limits (Elliott, Armitage, Baughan, 2005), mobile phone use while driving (White, Hyde, Walsh, Watson, 2010), and parental behaviours for childhood health (Hamilton, Cleary, White, & Hawkes, 2016; Hamilton, Hatzis, Kavanagh, & White, 2015). Qualitative research and belief elicitation methods have also provided richer understandings of why people decide to drive through floodwater (Hamilton et al., 2016a; 2016b). Given the dearth of research on avoiding driving through floodwater and the importance of context to this behaviour, using a combination of qualitative and belief elicitation methodologies would help to facilitate deeper understanding of the phenomenon of interest as well as provide complimentary evidence for the beliefs that motivate avoiding driving through floodwaters. Not only has research shown support for the use of the TPB belief-based framework to better understand behaviour, but an emphasis on the need for conducting more qualitative research into areas of drowning concern has been conveyed (Peden et al., 2016a;

Peden, Franklin & Leggat, 2016b; WHO, 2014).

1.2 The Current Research

A TPB framework was used to guide the current research. First, we aimed to elicit the TPB belief-based measures to identify salient beliefs likely to be influential in guiding individuals' decision making for the target behaviour, in this case, avoiding driving through floodwater. Next, we aimed to assess if the TPB global measures of attitude, subjective norm, and perceived behavioural control, which are conceptualized as summaries of people's beliefs, would predict the target behaviour. This allowed us to examine the theory's predictive validity and to estimate the relative importance of attitude, subjective norm, and perceived behavioural control. Given that we also wanted to understand the factors that provide the basis for these variables in order to design future effective behaviour change interventions, we needed to elicit and assess the accessible behavioural, normative, and control beliefs.

In Study 1, a qualitative research design using interview methods and based on a TPB belief-based framework was adopted to gain a detailed understanding of the experiences and beliefs of individuals who had intentionally decided to avoid driving through floodwater. In Study 2, a survey research design was used to facilitate deeper understanding and complimentary evidence of the factors that guide decisions to avoid driving through floodwater. First, we aimed to elicit the salient beliefs that underpin individuals' decisions to avoid driving through floodwater using the TPB belief-based framework as in Study 1. We also aimed to augment the interview data from Study 1 using open-ended questions to explore participants' awareness of information on driving through floodwater and understanding of the meaning of floodwater. Second, we aimed to identify the TPB social-cognitive predictors of this target behaviour. Specifically, we expected that attitude, subjective norm, and perceived behavioural control would predict intentions to avoid driving through floodwater, controlling for background factors known to influence individuals' decision making in this context.

2 Method

2.1 Participants

A purposive sampling method (Patton, 2002) was used to recruit Australian adults who held a registered driver's licence and met the experience criteria of having decided to avoid driving through floodwater. Individuals were recruited using social media posts, online media releases, university broadcast emails, and distribution of recruitment cards. For the purposes of recruitment, *avoiding a flooded road* was defined as encountering floodwater and intentionally avoiding crossing it by consciously stopping or turning around. In the participant's experience they must have been the licenced driver, have chosen not to push through the floodwater in their vehicle, and made the decision to avoid driving through the water that had not been directed by the presence of police or physical barriers. Several minor local flood events took place during the recruitment period; however, many participants reported on experiences outside of these incidents. Participants typically described avoiding flooded roads during or following heavy downpour and they avoided roads covered with pooled water or river and estuary overflow, predominantly avoiding inundated roads or causeways, but in some instances bridges. The majority of participants were community members from metropolitan and rural areas of the states of Queensland and New South Wales.

2.1.1 Study 1 Qualitative Study. The Study 1 qualitative sample ($N = 23$) were aged between 19 and 61 years ($M_{age} = 39.26$ years), with the majority being female ($n = 17$) and coming from an English speaking background ($n = 21$). While the majority of experiences described were recent (< three years), a few reports were historical in nature (> 10 years). At the time of the experience, the majority of participants ($n = 19$) drove small sedan or hatchback two-wheel drive vehicles (e.g., Ford Fiesta), one participant drove a two-wheel drive utility, two participants drove medium four-wheel drive vehicles (e.g., Toyota Rav 4), and one participant drove a large four-wheel drive (e.g., Toyota Prado). Provisional and open unrestricted licences were held by 2 and 21 of the participants, respectively; and, drivers held between 1 and 45 years of driving experience ($M = 20.65$). An almost equal number of participants held a university ($n = 12$) and non-university

degree (*n* = 11) qualification. Participants were offered a department store gift voucher valued at AU$10 as an incentive to participate in the study.

  2.1.2 Study 2 Survey Study: The Study 2 survey-based sample (*N* = 157) were aged between 17 and 65 years (M_{age} = 25.17 years, *SD* = 11.76), with the majority being female (*n* = 110) and coming from an English speaking background (*n* = 142). Provisional and open unrestricted licences were held by 89 and 68 of the participants, respectively; and, drivers held between 1 and 43 years of driving experience (*M* = 8.13, *SD* = 10.73). University and non-university degree qualifications were held by 31 and 126 participants, respectively. Experiences explored in this study had all occurred within the past five years. Participants were offered the chance to win one of three department store gift vouchers valued at AU$50 as an incentive to participate in the study.

2.2 Design and Procedure

  Ethical approval was granted by the Institutional Human Research Ethics Committee (PSY/A9/15/HREC), and forms part of a larger body of research investigating drivers' experiences during floods (Hamilton et al., 2016a; Hamilton, Peden, Keech, & Hagger, 2017). This study and the current data reported are independent of all other studies. In both Study 1 and Study 2, participants were given an information sheet explaining the study. After providing consent, participants completed a brief demographic survey and then the semi-structured interview (Study 1) or proceeded to the online survey (Study 2).

  The research comprised of two distinct Studies with qualitative and quantitative designs to facilitate deeper understanding and complimentary evidence of the factors that guide decisions to avoid driving through floodwater. Study 1 used semi-structured interviews and adopted a theoretical thematic analysis approach (Braun & Clarke, 2013). Interviews were conducted via telephone or in person at a location convenient to the participant and lasted approximately 30 minutes. Interviews were conducted by a researcher with training and experience in qualitative methods. Participants were asked to openly share their experience about avoiding driving through floodwater, along with their beliefs that facilitated this decision. Interviews were audio-recorded and transcribed verbatim

(removing any identifying data and assigning pseudonyms) by the author. Study 2 comprised a survey-based, cross-sectional design using open-ended and closed questions to elicit the knowledge and beliefs of individuals who had intentionally decided to avoid driving through floodwater as well as identify the social-cognitive predictors for this target behaviour. Participants completed a self-report online questionnaire. Data from both interview transcripts and open-ended survey responses were imported in NVivo software (Version 11.0) to facilitate coding. Gift vouchers were drawn on completion of the study and all participants were given the option to receive a summary of the research findings if requested.

2.3 Measures

The target behaviour of interest in the current study was *avoiding driving through floodwater*. Geoscience Australia (2014) defines "flooding" as "a natural phenomenon that occurs when water covers land that is normally dry". The behaviour of avoiding driving through floodwater is deliberate and therefore does not include being deterred by means of police, emergency personnel or similar, or the presence of road closure signs or barriers. To explore this specific behaviour, an interview protocol and online survey were developed to elicit beliefs underpinning decisions to avoid driving through floodwater. In both Study 1 and Study 2, a brief demographic survey was completed by all participants to collect information on participants' age, gender, marital status, postcode of residence, highest level of education, years of driving experience, and current licence status.

In Study 1, a semi-structured interview guide was developed using open-ended questions to stimulate discussion on drivers' experiences (Section 1 of interview guide) and beliefs (Section 2 of interview guide) toward the target behaviour. It was expected that this approach would produce rich and detailed self-directed narratives that would highlight key factors important to the individual's personal experience. The interview guide was pilot tested with two participants and feedback was used to slightly revise questions to improve participant understanding. Both lines of questioning, outlined in Supplementary Table 1, were designed to elicit understanding of the social-cognitive

influences underpinning driver behaviour during floods. At the conclusion of the interview, participants were invited to share any additional thoughts about their experience and if they believed the interviewer had missed anything. Confirming summaries were used throughout the interviews to validate participant responses and two final interviews were conducted to verify theoretical saturation, observing that the additional data failed to generate new information.

Study 2 consisted of an online survey developed using the same open-ended questions as Study 1, Section 2 (see Supplementary Table 1) and two additional open-ended questions related to participants' awareness of information on driving through floodwater and understanding of the meaning of floodwater: "In a few sentences, please tell us what information about driving through floodwater you are aware of?"; "In a few sentences, please describe what you understand floodwater to mean?". The survey also included closed questions that assessed the quantitative TPB global measures that were used to predict individuals' intentions to avoid driving through floodwater. Multi-item psychometric measures of intention (three items), attitude (three items), subjective norm (four items), and perceived behavioural control (four items) with respect to the target behaviour were developed based on TPB guidelines (Ajzen, 2006). See Supplementary Table 2.

2.4 Analytic Strategy

2.4.1 Study 1: Qualitative Study. Theoretical thematic analysis was used to analyse the data (Braun & Clarke, 2013). This method was selected as it is guided by an existing theory and theoretical concepts, as well as the researcher's standpoint and disciplinary knowledge. The data were analysed according to the six phases set out by Braun and Clarke (see Braun & Clarke 2006, 2013 for a detailed description of these six phases). Author SP coded the data. To ensure stability of coding, a code-recode procedure was conducted for 15% of the data and 10% of the data were co-coded by an experienced researcher. Any inconsistencies in coding assignment were resolved in discussions with both authors. Where possible, themes were assigned names from the data.

2.4.2 Study 2: Survey Study, Part A. Data were analysed using thematic content analysis (Braun & Clarke, 2006; Joffe & Yardley, 2004) and coded according to the research questions. Author SP coded the data using similar data analytic strategies as Study 1. All codes were reviewed by authors SP and KH and any inconsistencies in coding assignment were resolved in discussions with both authors. Beliefs that were mentioned by at least 10% of the sample were included (Ajzen & Fishbein, 1980; Sutton et al., 2003).

2.4.3 Study 2: Survey Study, Part B. A hierarchical multiple regression analysis was conducted with intention to avoid driving through floodwater as the dependent variable and demographic and social cognitive measures from the TPB as independent predictors. Sex, years of driving, licence class, past behaviour (extent avoided), and times driven through floodwaters were entered together in step 1 of the analysis. The TPB variables of attitude, subjective norm, and perceived behavioural control were entered together in step 2.

3 Results

3.1 Study 1: Qualitative Study - Data Findings

Participants' qualitative descriptions have been organised around the two main discussion sections that framed the interview guide and the resultant beliefs underpinned by the TPB belief-based framework that emerged from the data as influencing driver behaviour in this context. The categories that emerged across the individual interviews were similar; thus, the most salient emerging themes within the category expressed across all participants are presented. The themes presented below emerged from drivers' descriptions of their actual experiences of avoiding driving through floodwater and the beliefs they discussed as underpinning their decisions for this behaviour. Figure 1 presents a thematic map of the social-cognitive beliefs underpinning driver behaviour to avoid driving through floodwater. See Supplementary Table 2 for a summary of the interview concepts, key themes, and supporting quotes of behavioural, normative, and control beliefs to avoid driving through floodwater. Extracts are classified by participant number (e.g., *P01)*

3.1.1 Behavioural Beliefs: Advantages and Disadvantages of Avoiding Driving Through Floodwater

3.1.1.1 *Calculated decision process.* Some drivers described the choice to avoid driving through floodwater as a calculated decision. They reported evaluating benefits and risks of the situation and believed that the advantages outweighed the disadvantages in the instances where they did avoid the floodwater. It should be noted, however, that all but one of the drivers who indicated this belief, spoke about alternate situations when they had appraised the floodwater to be safe enough to enter and decided to drive through. This suggests that in situations where advantages are not evaluated as outweighing the disadvantages, drivers may choose not to avoid the floodwater.

3.1.1.2 *Didn't damage the car.* Not damaging the vehicle was discussed as an advantage of avoiding driving through floodwater by all drivers. For some it was the absence of physical damage to the car that was the benefit, for others it was the avoidance of potential ramifications that damage to the vehicle may have entailed. In such cases, avoiding the floodwater was a means of reducing the potential financial risk of repairing or replacing vehicles and the risk of losing the convenience of owning personal transportation.

3.1.1.3 *Safety first and foremost.* Most drivers encountered floodwater across the road on their own and placed importance on their "safety [of themselves] first and foremost." Avoiding putting their lives in danger appeared to be an influential factor in participants' decisions to avoid the floodwater. For a few drivers who had passengers in the car, the safety of their passengers was also a consideration. One driver reflected that she saw the safety of her passenger to be more important than the safety of herself.

3.1.1.4 *Avoided "feeling like an idiot".* Drivers were influenced to avoid driving through floodwater in an effort to avoid the potential consequence of negative judgement for their behaviour if they did attempt to cross the water. It emerged that by avoiding driving through floodwater, drivers believed that they avoided the embarrassment and shame and feeling like an "idiot" they anticipated would come with getting stranded in the floodwaters.

3.1.1.5 *Being a role model.* For some drivers with children in the car, being a good role model for their children was an influencing factor in their decision to avoid driving through the floodwater. Modelling this safe behaviour to other drivers on the road was also seen as important. Showing an alternate course of action was spoken about both in the sense that it may make others reconsider their choice or may help reaffirm the decision other drivers already wanted to make and give them the confidence to go against the crowd.

3.1.1.6 *Inconvenient (but not so terrible).* For many participants, the added time to turn back and use an alternate route was seen as the main inconvenience associated with avoiding driving through floodwater. Although many discussed the nuisance, it was viewed as a relatively minor inconvenience compared to the risk of not avoiding the floodwater. Some drivers, where flooding added substantial time to reaching their destination, still choose to avoid driving through the floodwater by opting to abandon where they were going. The inconvenience of not making it to their destination and the potential ramifications that may have occurred for drivers (e.g., loss of income, wasted petrol) were identified as disadvantages of avoiding driving through floodwater, but not sufficient to make the decision to drive through.

3.1.1.7 *Negligible or non-existent disadvantages.* For many drivers, descriptions of their beliefs about the disadvantages of their behaviour were followed by statements about how these disadvantages did not hold much influence. They commented that the disadvantages were not sufficient to influence their behaviour. Other drivers did not see any disadvantages resulting from the decision to avoid driving through floodwater.

3.1.2 Normative Beliefs: Social Pressures of Avoiding Driving Through Floodwater

3.1.2.1 *Approval of important others.* Family members, in particular parents and significant others, as well as friends and employers were among the individuals and groups that drivers identified as supporting or approving of their decision to avoid driving through the floodwater. Some drivers also spoke about getting praise for their safe behaviour from family members and

passengers in the car. Many attributed this approval and support to a shared concern for the safety of their loved ones.

3.1.2.2 *Everyone would approve*. Some drivers agreed that the alternate behaviour, of driving through the floodwater, is frowned upon and there was a perceived consensus in the community that avoiding driving through floodwater was the supported behaviour. Other drivers also spoke about how they believed members of the community wanted people to be safe and therefore did not want people driving through floodwater. This strong belief that everyone would approve of avoiding driving through the floodwater was supported by comments that no one would disapprove of the behaviour.

3.1.2.3 *Think of the rescuers*. Furthermore, participants believed that people who may have had to deal with the repercussions of driving through floodwater, were more likely to approve of those drivers who choose to avoid driving through floodwater. This included support from ambulance drivers, nurses, doctors, police, and most saliently, state emergency service personnel. Several drivers spoke about considering the safety of rescue personnel and believed this to be moral obligation toward others.

3.1.2.4 *Disapproval of other motorists*. When faced with the decision to avoid driving through floodwater some participants reported a perceived pressure from other motorists behind them. No drivers reported enduring explicit acts of frustration (e.g., horn beeping); however, regardless of the uncertain reality of the pressure, the assumed disapproval was still felt. Drivers believed the motorists behind them may be disapproving of their choice because they would have been temporarily hindered from attempting the crossing while the participant turned around. Although participants acknowledged the disapproval of the other drivers on the road, some commented on the fact that they did not know these people, they were "just randoms", and that their opinion was of little concern.

3.1.3 Control Beliefs: Facilitating and Inhibiting Factors of Avoiding Driving Through Floodwater

3.1.3.1 *Making plans and using existing plans*. When participants spoke about their experiences of avoiding driving through floodwater, the development and utilisation of plans or avoidant strategies was salient. For some participants, the planning process itself or the enactment of an existing plan to avoid driving through floodwater seemed to be cued. These cues appeared to differ for participants both in what signal cued the planning process and the temporality of the cue. Participants described the influence of environmental cues on initiating planning an alternate course of action, such as noticing unusual traffic behaviour (e.g., seeing no traffic travelling back on the opposite side of the road), news reports, weather warnings, heavy rain downpours, or witnessing the build-up of water in other flood prone areas. Participants also described differences in when they were cued to begin planning an avoidant strategy. Some drivers were cued to begin making alternate plans before their trip commenced, some were cued during their commute, and others were cued once they had encountered the flooded road itself. While only some drivers identified explicit cues initiating the formulation of plans (e.g., overflowing gutters on the sides of the road), all drivers avoided driving through the floodwater using a plan or strategy to carry this out.

Many participants, once cued, described a planning process that lead to various avoidant strategies to crossing the floodwater including taking an alternate route, staying with friends or family, or seeking out alternate paid accommodation. This planning process and the implementation of the strategies were facilitated by various factors. For many of the drivers who encountered floodwater in a familiar area, knowledge of an alternate route enabled their use of that plan. However, not knowing an alternate route did not stop those drivers who encountered floodwater in an unfamiliar area from seeking one out. For some of those that did not know an alternate route, other strategies such as asking local residents for directions, using radio or map resources, and following other vehicles were useful in finding a different path to reach their destination. For various participants attempting to get home, knowing they had somewhere else to stay, whether with a friend or paid accommodation (and being financially prepared) made it easier for them to turn around. While some participants engaged in the planning process after encountering a cue, for

other drivers the cue simply prompted the enactment of an existing strategy that had already been planned pre-emptively.

Being aware of the possibility of flooding resulted in some drivers preparing a plan that could be enacted later when cued. Having this strategy premeditated meant that when participants were cued by rain or weather reports they described carrying out the pre-emptive measures such as staying at home or taking the alternate route initially. Knowing that they might encounter floodwater, a few participants spoke about how they had planned and prepared the resources (e.g., food and clothing) to wait for flooding to disperse. Therefore, when they did encounter a flooded road it cued their plan to "wait it out".

3.1.3.2 *Experience, observation, and stories***.** Having prior experience of the effects of floodwater appeared to influence drivers' behaviour. For a few drivers, personally experiencing failing to cross floodwater previously was described as a strong influence and referred to many times within the discussions. Having had such an aversive encounter with driving through floodwater, the chance of a repeated occurrence made it easier for those participants to turn around. For other drivers, knowing somebody who had passed away from attempting to cross floodwater or driving in wet conditions influenced them to avoid driving through the floodwater. In addition, observing someone fail to cross the water or even struggle to cross the floodwater assisted drivers in deciding to carry out the alternate course of action of not driving through. Some participants also emphasised the function of storytelling and its role in influencing their decision to avoid driving through floodwater. Several told of stories shared by friends or family members that came to the forefront of their mind when they encountered the floodwater. For other drivers the stories came from television coverage and news reports, and these tales, although not personally relevant, seemed to be quite salient, given the level of detail drivers recalled about the stories.

3.1.3.3 *Environmental factors***.** Drivers spoke about how aspects of the physical environment of the situation and the floodwater itself helped them to avoid driving through the submerged road. The depth, distance inundated, movement of the water, and road type or known

condition all appeared to be important for drivers' evaluation of the situation as dangerous. Being "out in the middle of nowhere" also was discussed as causing doubts about help being accessible if needed. The isolation of the flooded location was influential in that the risk was believed to be greater in those scenarios.

      3.1.3.4 *Ill-equipped car*. Another salient facilitating factor that emerged was that drivers did not believe their car was capable of crossing the floodwater. Not being confident in the ability of their vehicle to navigate the floodwater, led drivers to speak about how being in a smaller ill-equipped car increased the associated risk. Some drivers reported comparing their own car to the cars they observed driving through and using that to help gauge the ability and suitability of their own vehicle. This seemed to be especially important for drivers that expressed experience in four-wheel drive settings or had driven through floodwater successfully before. Of note, one driver spoke about how if they had been in a bigger more capable car they then might not have avoided the floodwater.

      3.1.3.5 *Destination wasn't that important anyway*. The urgency of the destination seemed to influence whether drivers would avoid the floodwater. Participants described the destinations in the experiences where they avoided as unimportant, but spoke of instances (e.g., medical emergencies) where they would find it hard to avoid driving through floodwater if the destination was perceived to be urgent.

      3.1.3.6 *Other options are no better.* Uncertainty about the alternate avoidant strategies was a potential barrier discussed by some of the drivers. Whether alternate roads would also be flooded or simply not knowing the area and the prospective of getting lost could potentially have tempted drivers to cross the floodwater. Further, not having access to alternate routes was reported as a challenge to making the decision to avoid driving through floodwater. Thus, having plans in place was fundamental to decision making.

      3.1.3.7 *Perceived urgency to reach the destination*. Some drivers discussed that if they felt a real urgency to get home or to a particular destination than this would make it harder for them to

avoid driving through floodwater. A few participants specifically spoke about this pressure to get home stemming from responsibilities they perceived as needing to be attended to, such as having children or pets at home. For a few of the drivers, knowing an alternate route meant they could make it home to their perceived obligations by taking a longer course. For others, being able to contact their partner at home (via mobile phone) or meet others at another location was influential in overcoming this barrier to avoiding driving through the floodwater.

3.1.3.8 *Fatigue*. For a few drivers, fatigue was an important factor that tempted them to cross the flooded road, particularly if the alternate route added significant time. In particular, these drivers reported being exhausted and the option of taking a longer route presented as less appealing. For these drivers, it was being presented with other factors that challenged this belief (e.g., seeing inundated vehicles in the floodwater) and influenced their decision to take the longer route home.

3.2 Study 2: Survey Study - Data Findings

3.2.1 Study 2: Survey Study, Part A. Results revealed participants were able to identify information about driving through floodwater (e.g., dangerous/risky) and what floodwater means (e.g., body of water over road). In addition, a range of behavioural (e.g., didn't damage the car) normative (e.g., approval of important others), and control (e.g., environmental factors) beliefs were elicited (see Table 1). Over half of these beliefs supported findings in Study 1 and, thus, provide preliminary evidence for the prevalence of these beliefs (see Table 1, beliefs denoted with the superscript letter a). These included 4/7 behavioural beliefs: didn't damage the car, safety first and foremost, being a role model, inconvenient; 3/6 normative beliefs: approval of important others, rescuers, other motorists; and, 5/9 behavioural beliefs: environmental factors; experience, observation, and stories; ill-equipped car; urgency to reach destination; other option no better. Other beliefs that were not identified in the interviews also emerged (see Table 1). However, it should be noted that these were only considered by less than 15% of the participants except for the normative beliefs: "government" and "no one would disapprove", and control belief: "knowledge of consequences".

3.2.2 Study 2: Survey Study, Part B. Means, standard deviations, and bivariate correlations for study variables are presented in Supplementary Table 3. Participants reported high intentions to avoid driving through floodwater ($M = 6.44$, $SD = .85$), with subjective norm revealed as having the highest association with intentions ($r = .49$, $p < .001$). For the hierarchical regression analysis predicting intentions, the control variables entered in Step 1 resulted in a statistically significant model and explained 22% of the variance. Sex (females more likely to intend to avoid), past behaviour (previous avoiding more likely to intend to avoid), and times driven through (more times driven through less likely to intend to avoid) were revealed as statistically significant predictors. Attitude, subjective norm, and perceived behavioural control were entered in Step 2 and resulted in a statistically significant increase in the variance explained, with the model explaining 55.3% of the variance. In the final model, sex, attitude, subjective norm, and perceived behavioural control were significant predictors of intentions to avoid driving through floodwater (see Table 2).

4 Discussion

Despite public health campaigns, lives are lost each year due to driving through floodwater. Current results add to the literature supporting the TPB's validity for an important driving behaviour; avoiding driving through floodwater. This is consistent with findings from other studies on risky driving behaviours such as speeding, tailgating, drink driving, overtaking dangerously (Parker et al., 1992), texting while driving (Nemme & White, 2010), breaking speed limits (Conner et al., 2007), and driving through floodwater (Pearson & Hamilton, 2014), as well as studies on safe driving behaviours such as in truck driver's compliance with safety regulations and road traffic rules (Poulter, Chapman, Bibby, Clarke & Crundall, 2008). While more research is needed, current findings provide emerging evidence for the importance of attitude, subjective norm, and perceived behavioural control in this context. It was therefore central to the aims of this research to elicit and assess the accessible behavioural, normative, and control beliefs to understand the factors that provide the basis for these variables so that future theory-based behaviour change interventions aimed at getting individuals to avoid driving through floodwater can be designed.

4.1 Personal Knowledge

Current findings showed that individuals are aware of the dangers of driving through floodwater and understand the meaning of a flooded waterway, and knowledge of consequences emerged as a facilitator belief for avoiding driving through floodwater. This is not surprising given the increased attention the issue of driving through floodwater has received in the Australian media and public health messages. However, despite this knowledge, yearly coronial reports indicate that drowning as a result of driving through floodwater is an ongoing issue (Hamilton et al., 2016b; Royal Life Saving Society – Australia, 2016). This highlights that having accurate information may not always produce desirable behaviour (Paton et al., 2006; Sheveller & Riggs, 2015), reinforcing that it may be more useful to focus efforts on the psychological influences that guide the behaviour by gaining insight into the beliefs about the behaviour. In translating this insight to intervention, beliefs that are contrary to or supportive of the desired behaviour can then be challenged or strengthened, respectively.

4.2 Theory of Planned Behaviour and Salient Beliefs

4.2.1 Attitudes and behavioural beliefs. According to the TPB, behavioural beliefs underpin individuals' attitudes. They are formed by experiencing the perceived advantages and disadvantages of engaging in a specific behaviour and are affected by the perceived consequences that were experienced (Ajzen, 1991). In the current research, positive attitudes toward avoiding driving through floodwater significantly predicated intentions to avoid, indicating that individuals' behavioural beliefs individuals are important when it comes to making decisions to avoid driving through floodwater.

The behavioural beliefs identified in Studies 1 and 2 indicated that decisions to avoid driving through floodwater involved a calculated decision-making process, which aligns with the conceptualisation of human behaviour as a reasoned action in the TPB (Ajzen, 1991). Further, evaluations of positive (e.g., didn't damage the car, safety first and foremost) and negative (e.g., inconvenient) outcomes suggests that when faced with a flooded road, drivers in the current study

evaluated the benefits, costs, and probability of alternate actions, creating a measure of expected value for possible outcomes (Eiser et al., 2012). As people prefer the most certain option when choosing between certain and uncertain gains of the same expected value (Kahneman & Tversky, 1979), choosing to avoid driving through floodwater may be because individuals perceived it to produce more certain outcomes—such as not damaging the car—than the risky alternative. Previous research has shown that drivers who had previously entered floodwater regretted their action (Hamilton et al., 2016b). In the current research, perceiving the beliefs of not damaging the car, ensuring the safety of self and others, not needing to be rescued, and not getting stuck as advantages in this context may reflect an anticipation of this regret (Brewer, DeFrank & Gilkey, 2016). Consistent with recent literature associating anticipated regret with protective behaviours (Brewer et al., 2016), merely imagining future regret may have influenced safer action. Personal safety research has shown that reasons for feeling safe and secure often resonate from an individual's own behaviour (Chen & Skillen, 2006), in this case choosing to avoid an uncertain and potentially dangerous situation. Thus, persuasive messages that highlight the responsibility for safety, both of self and others, may prove useful in forming positive attitudes toward avoiding driving through floodwater. In addition, creating financial costs, which may elicit attitude change by targeting the beliefs of car damage and rescue efforts, has been shown to influence behaviour (Brubacher et al., 2014; Meirambayeva et al., 2014). It might therefore be useful to create public awareness that many insurance companies are not obliged to pay claims for damages sustained while deliberately driving through floodwater to highlight the advantage of an undamaged car (Gissing et al., 2016). Instituting legislation such as the "stupid motorist" law adopted in the state of Arizona, USA, which holds drivers liable for emergency responses in flood areas, might also be an effective strategy to endorse many of these advantages of avoiding driving through floodwater (Chang et al., 2011).

The anticipation of other emotions was also seen to influence driver action. The importance placed on avoiding potential embarrassment and shame shows merely perceiving the negative emotional consequences of "feeling like an idiot" may have impacted drivers' behaviour

(Loewenstein & Lerner, 2003). Studies based on extensions of the TPB have shown the importance of anticipated affect, which refers to an individual's anticipated feelings following a certain action, on individuals' decision making (Rivis, Sheeran & Armitage, 2009). Using persuasion to induce emotions and stimulate action (Johnson, Wolf, & Maio, 2017) has been shown to strengthen the influence of anticipated affect and, thus, may be a useful behaviour change strategy to consider in this context. Similarly, the perception that their behaviour on the road may be modelled by others appeared to be an influential factor in current drivers' decisions. Just as the theme *being a role model* suggested drivers were thinking about how other road uses may follow their actions around flood water, another study (Fleiter, Lennon & Watson, 2010) identified that drivers' speed related behaviour was influenced by individuals wanting to present an image of "the responsible driver" to others. Research looking at social influences on driver speed found that drivers typically drove to the limit when they were not alone in the car and parental role modelling was proposed as one reason for this finding (Fleiter et al., 2010). This desire to set an example for others appears be a valid concern as research is suggestive that parental driving habits are emulated by their children (Ferguson et al., 2001) and that driver speed is often influenced by the speed of surrounding drivers (Haglund & Aberg, 2000). Therefore, appealing to motorist's desire to be a role model for others may have an impact on attitudinal change in this context.

It should also be noted that disadvantages, such as inconvenience and being stranded, were considered in this context. However, the observed tendency of drivers to describe and classify these disadvantages of their action as minimal or negligible may have enabled the advantages to remain more salient, potentially contributing to the strength of intentions to avoid the floodwater (Conner, 2010). That is, while the disadvantages were recognised, their trivial nature (as perceived by the individual) meant they were not sufficient to change behaviour. Although the disadvantages were considered negligible, it might be judicious for safety messages aimed at changing individuals' attitudes to use strategies that enhance the salience of the advantages of avoiding driving through

floodwater yet also challenge the disadvantages (e.g., promoting the trivial nature of inconveniences in this context).

4.2.2 Subjective norm and normative beliefs. Normative beliefs are proposed as a source of pressure from important others to perform a given behaviour and underpin the subjective norm construct in the TPB. In the current research, perceptions of pressure to avoid driving through floodwater (i.e., subjective norm) significantly predicated intentions to avoid and, thus, the normative beliefs individuals hold for this behaviour may also be important considerations.

In uncertain situations, people often turn to others for information and guidance (Eiser et al., 2012). In the current research, important others (e.g., family, friends) were considered major sources of this perceived pressure for drivers to avoid going into the floodwater. In addition, considering the extant publicity in the general community about the dangers of driving through floodwater, drivers also acknowledged the government would approve, and moreover, concern for the safety of rescue personnel. This suggests that those who avoided driving through floodwater thought about the moral correctness of their actions and possible repercussions of potential inaction on others. TPB-based studies have shown the important of moral correctness (or incorrectness) in influencing individuals' decisions (Rivis et al., 2009), including the road behaviours of breaking the speed limit (Conner, Smith & McMillan, 2003), texting and driving (Nemme & White, 2010), and deciding not to drink and drive (Moan & Rise, 2011). Interestingly, however, and in support of the idea that the determinants of engaging in a behaviour are not the same as the determinants of avoiding it (Richetin et al., 2011), is that previous research has shown drivers who entered floodwater did not feel a moral obligation, viewing surrounding people as sources of emergency assistance, giving them confidence to drive through the water (Hamilton et al., 2016a). Consequently, some drivers identified that not everyone approved of their behaviour.

Current findings indicated that a level of social disapproval could also be perceived for deciding to not drive through the water (e.g., drivers behind getting impatient). For these drivers, however, this pressure did not affect the decision to avoid driving through, potentially because the

source of the pressure was coming from a stranger not a significant other, making the disapproval more distal (Scott-Parker, Watson, King, & Hyde, 2012). In this research, drivers identified those more proximal to them (e.g., family, friends) as approving of their behavioural choices, supporting the proposition that the quality of the relationship may determine the magnitude of the approval's influence (Eiser et al., 2012). Although it should be acknowledged that individuals who have driven through floodwater also report those close to them as sources of influence for making the risky decision of driving through in some instances (Hamilton et al., 2016a). This highlights the importance of normative pressures for driving behaviours during floods.

Targeting normative beliefs, therefore, would be useful for behaviour change in this context; a strategy commonly employed to reduce harmful behaviours (Miller & Prentice, 2016). Publicising that most people approve of avoiding driving through floodwater and carry out the behaviour themselves may be effective in creating or strengthening the normative expectancies. Considering these types of approaches are most effective for individuals who are behaving inconsistently with their intentions (Miller & Prentice, 2016), the large number of drivers that reported having driven through floodwater in the past despite evaluating it as unwise may make promising targets. Provision of normative information may help in making the social pressure perceived from others on the road seem illusory and highlight that disapproval is unlikely to follow the safe behaviour (Miller & Prentice, 2016). Further, current findings showed that the way drivers' view their behaviour affecting others has implications. Making known that decisions around floodwater can be influenced by what other motorists do (Gissing et al., 2016) and highlighting the hazards that driving through can create for rescuers could assist in invoking a moral obligation that encourages people to take the safer course of action. This suggestion is supported by previous research that has shown the more a person views the behaviour as moral and right, the more likely they are to engage in the preferred behaviour (Nemme & White, 2010).

4.2.3 Perceived behavioural control and control beliefs. In the TPB control beliefs underpin perceived behavioural control and are formed from people's evaluations of whether

behavioural performance will be difficult or easy and from their perceived power over resources, skills, and opportunities for the behaviour (Ajzen, 1991). If drivers think they have the ability and confidence to avoid driving through the floodwater, they are more likely to make this perceived 'safe' decision. This is supported by the findings in the current research in that perceived behavioural control over avoiding driving through floodwater significantly predicted intentions to avoid. This suggests that the control beliefs individuals hold for this behaviour, in addition to behavioural and normative beliefs, may be useful to consider in this context.

Research has indicated that many drivers who entered floodwater had never intended to drive through, but did (Hamilton et al., 2016a). The drivers in the current research shared the same intention, yet it appeared that their intentions translated into behaviour through the enactment of a plan. Previous research has shown that specifying when, where, and how a goal will be achieved enhances the accessibility of the specified response (Gollwitzer & Sheeran, 2006). This may explain why drivers who already had a predetermined plan or began making a plan when cued (e.g., by the heavy rain, water building up on the roads, news reports of flooding) were successful in avoiding the floodwater. It has been shown that environmental cues are often insufficient in deterring risky behaviour (Drobot et al., 2007). However, when used in a context where they have been linked to a pre-determined plan, environmental or contextual cues can be effective in encouraging positive behaviours (Gollwitzer & Sheeran, 2006; Hagger et al., 2016). Current Australian campaigns promote the use of alternate plans (e,g., "If its flooded forget it" – Make a plan; Queensland Government, 2017) but do not provide drivers with the tools to create effective plans, which is important given the effect of planning for subsequent intended behaviour may be dependent on the skill of the planner and the quality of the plan (Allan, Sniehotta, & Johnston, 2013). Thus, it may be useful to teach people how to create 'if-then' plans, also known as implementation intentions (Gollwitzer, 1999). For example, "IF my normal road is flooded THEN I will go to my sister's house until the flooding subsides". Such initiatives have been effective in increasing safe driver behaviour across different situations (Brewster, Elliott, McCartan, McGregor, & Kelly, 2016;

Elliott & Armitage, 2006). To facilitate the effectiveness of if-then plans, the intention should be linked to a suitable situational context (e.g., a flooded road) or an environmental cue (e,g., severe rain). Technological advancements have paved the way for cues to be distributed to drivers in the form of information sent to car navigation systems (Gissing et al., 2016) or text messages which have been shown to act as successful cues in other settings (Prestwich, Perugini & Hurling, 2010).

Having had a past aversive experience with driving through floodwater also emerged as a facilitator belief to enact the safe driving action of avoiding driving through. This is supported by the extant literature that has shown past behaviour to be a strong and significant predictor of future behaviour (Ouellette, Wood, & Eisenberg, 1998), including in the context of driving through floodwater (Pearson & Hamilton, 2014). Observation and stories also emerged as facilitator beliefs in this context. Vicarious learning (Ashford, Edmunds, & French, 2010) may explain how seeing or hearing about others' unsuccessful attempts at crossing floodwater influence the decisions of those who choose to avoid driving through floodwater (Eiser et al., 2012). The availability heuristic suggests individuals may give disproportionate weight to certain noteworthy occurrences (e.g., exposure to vivid press coverage) (Tversky & Kahneman, 1973), impairing estimates of probability (Eiser et al., 2012). Hence, it is not surprising that drivers in the current research exposed to unsuccessful floodwater stories or news reports held salient beliefs about the likelihood of aversive outcomes and, therefore, avoided the situation.

Considering the hazardous nature of learning through experience in this risky context (i.e., previous unsuccessful attempt of crossing of floodwater), the emergence of observation and storytelling as alternate means of learning is promising. Safe vicarious learning opportunities could be created through simulation (Cook et al., 2013) and mental imagery (Hagger et al., 2012). Mass media campaigns also have the potential to facilitate learning through the use of narratives and storytelling (Hinyard & Kreuter, 2007), and have been shown to be effective in producing positive changes in behaviour; yet, they must be used with respect to research findings (Wakefield, Loken & Hornik, 2010). It is suggested that repeated short cycles of safety communications containing

efficacy messages built into the campaigns are most effective in addressing behaviours that are less common (Tannenbaum et al., 2015; Wakefield et al., 2010), such as avoiding driving through floodwater.

In addition, environmental factors of the situation, where perceived as dangerous, resulted in favouring safer options, perhaps through a heightened sense of risk perception. Drivers also made evaluations of the efficacy of their vehicles, perceiving them to be ill-equipped to navigate the floodwaters. This is important given only 60 centimetres of water can cause all vehicles to lose contact with road surfaces (NOAA, 2011), and that individuals' report vehicle capability as a reason to drive through floodwater (Hamilton et al., 2016b). This issue of vehicle capability needs urgent attention as current efforts to stress the poor efficacy of vehicles in floodwater are met with counter claims by vehicle manufacturers advertising the ability of their vehicles to cross great depths of water through illustration of engineering particulars and video footage. While these campaigns show specific vehicles, they are concerning due to prior research (Hamilton et al., 2016a) indicating that drivers derive efficacy to drive through floodwater based on more general vehicle characteristics such as having a large car, a four-wheel-drive, or a diesel engine. Thus, car owners may observe engineering particulars in these advertisements which are similar to their vehicle, and derive efficacy from that. Viewing footage of cars with similar characteristics successfully driving through floodwater may also reduce uncertainty associated with the decision to drive through floodwater, which is described above as a potentially important facilitator of decisions to avoid driving through floodwater. Therefore, to give drivers accurate perceptions about the efficacy of their vehicles, and the uncertainty surrounding the surface beneath the water, regulation of advertising is an area of interest. Government policies that banned tobacco advertising and the significant decrease in smoking that followed (Quentin, Neubauer, Leidl & König, 2007) demonstrate the potential of advertising guidelines in shaping behaviour.

Further, although beliefs held about the lack of importance in reaching a destination facilitated avoiding the floodwater, reports of driving through floodwater in the context of more

pressing circumstances (i.e., medical emergencies), suggests that this belief in times of urgency may be overridden. To strengthen beliefs that the destination is not worth the risk, messages could provide drivers with alternate options in emergency situations such as pulling over and calling emergency services to seek medical assistance. Other barriers, including the uncertainty of other options/lack of alternative route, fatigue, and observing others successfully cross, were reported as potential factors that could affect one's capacity in the future to avoid the risky option (Hockey, John Maule, Clough & Bdzola, 2000), which is consistent with research on driving through floodwater (Gissing et al., 2016; Hamilton et al., 2016a).

4.3 Conclusion

There is a dearth in research investigating driver decisions during floods. The current research had many strengths including using a comprehensive mixed-method approach based on behavioural theory that provided an in-depth understanding of the key attitudes, beliefs, and social cognitive factors that affect drivers' intentions to avoid driving through floodwaters. The research also collected the views of participants with experience in avoiding driving through floodwaters. Limitations of the research, however, should also be noted including a gender imbalance in that more women participated and, due to the unpredictability of flood events, intentions to avoid driving through floodwater and not actual behaviour was investigated, although we controlled for past behaviour. Despite this, the current study was able to identify salient themes around behavioural beliefs, normative influences, and perceived behavioural control factors that influence drivers' decisions to avoid floodwater. These findings can inform further formative research into drivers' behavioural decisions during flood events and can assist in intervention development, in turn saving lives otherwise lost in Australian waterways during times of flood.

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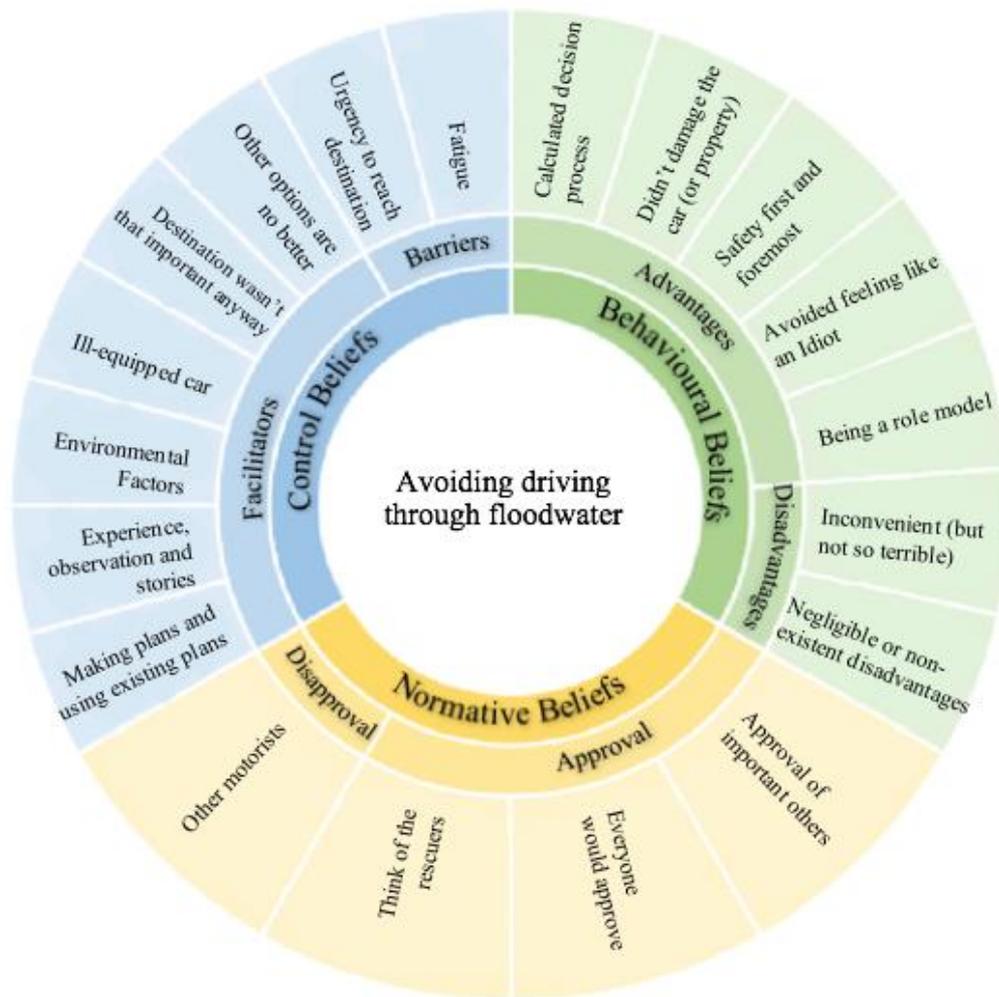
Figure 1. Avoiding Driving Through Floodwater – Study 1: Thematic Map Showing Key Social Cognitive Beliefs Underpinning Driver Behaviour

Table 1

Avoiding Driving Through Floodwater – Study 2: Summary of Modal Salient Beliefs (N=157)

Theme	Frequency	Percent
Personal Knowledge and Experience	N	%
Information about driving through floodwater		
Dangerous/risky	67	42.67%
Don't do it	63	40.13%
Uncertain/unpredictable	47	29.94%
Knowledge about nature of the floodwater (depth, debris, current, etc.)	41	26.11%
Loss of control of vehicle	31	19.75%
Understand floodwater to mean		
Body of water over road	72	45.86%
Caused by excessive rain	56	35.67%
Land that is wet that usually isn't	47	29.94%
Overflow from river/dam/creek	39	24.84%
Condition of road underneath can be compromised	17	10.83%
Theory of Planned Behaviour Beliefs		
Advantages		
Safety first and foremost (e.g., still alive, feeling safe, safety of others including passengers and other road users)[a]	138	87.90%
Didn't damage the car (or property)[a]	108	68.80%
Being a role model[a]	24	15.28%
Don't need to be rescued	22	14.01%
Didn't get stuck	18	11.47%
Disadvantages		
Inconvenient (e.g., time, takes longer, not reaching destination)[a]	106	67.5%
Being stranded (e.g., stuck between two flooded areas or nowhere to go)	19	12.10%
Approve		
Approval of important others (family, friends)[a]	127	80.89%
Rescuers (State Emergency Services, police, ambulance, fire)[a]	95	60.50%
Government	35	22.29%
Disapprove		
No one would disapprove	58	36.94%
Other motorists[a]	18	11.46%
Reckless thrill seekers	18	11.46%
Facilitators		
Environmental factors (e.g., road inundated, dark, fast flowing water, heavy rain)[a]	135	85.98%
Experience, observation, and stories (e.g., news reports and stories, seeing an unsuccessful attempt, own unsuccessful attempt)[a]	51	32.48%
Knowledge of consequences	38	24.20%
Passengers in the car	21	13.37%
Ill-equipped car[a]	18	11.46%
Barriers		
Urgency to reach destination (e.g., emergency situation, urgent destination, in a rush/hurry)[a]	69	43.95%
Other options no better[a]	30	19.10%
Seeing others successfully cross	17	10.82%

Note. Beliefs denoted with superscript letter a indicates beliefs also identified in Study 1 interview data.

Table 2

Avoiding Driving Through Floodwater – Study 2: Hierarchical Multiple Regression Analysis (N=157)

	Step 1					Step 2				
	B	B	sr^2	95% CI	Stats.	B	β	sr^2	95% CI	Stats.
1. Sex	.48	.25**	.06	[.19, .77]		.38	.13**	.04	[.12, .63]	
2. Years driving	.01	.17	.02	[.00, .03]		.01	.08	.00	[-.01, .02]	
3. Licence class	-.07	-.09	.01	[-.22, .08]		-.06	-.07	.00	[-.18, .07]	
4. PB: Extent avoided	.10	.18*	.03	[.02, .18]		.01	.02	.00	[-.07, .08]	
5. Times driven through	-.11	-.23**	.05	[-.19, -.04]		-.03	-.05	.00	[-.10, .05]	
6. Attitude						.17	.23**	.05	[.07, .27]	
7. Subjective norm						.26	.24**	.04	[.08, .44]	
8. PBC						.28	.27**	.05	[.12, .44]	
R^2					.16[a]					.39[b]
F					5.24***					11.08***
ΔR^2										.23
ΔF										17.71***

Note. Step 1 = Demographic and control variables included as predictors of intention to avoid driving through floodwater; Step 2 = Demographic and control variables and social cognitive variables included as predictors of intention to avoid driving through floodwater; PB = past behaviour, PBC = perceived behavioural control; [a]95% CI [.06, .26]; [b]95% CI [.27, .51]. *$p < .05$; **$p < .01$; ***$p < .001$

Supplementary Table 1

Avoiding Driving Through Floodwater – Study 1 and Study 2: Questions and Objectives for Theory of Planned Behaviour Belief-based Measures

Section 1: Two broad questions, used in Study1, were asked to allow participants to describe their experience of avoiding driving through floodwater	
Questions	**Objectives**
"If you are comfortable, can you tell me about the circumstances that led up to you avoiding driving through the floodwater?"; "Again, if you are comfortable, can you tell me about the actual experience of avoiding driving through the floodwater?"	These open questions allowed participants to share their experience and speak at length about influences that were meaningful to them.
Section 2: The theory of planned behaviour belief-based open-ended questions, used in Study 1 and Study 2, were asked to elicit participants' beliefs about avoiding driving through floodwater.	
Questions	**Objectives**
"What did you identify as the [advantages / disadvantages] of avoiding driving through the floodwater?"	Elicit behavioural beliefs
"Who were the individuals or groups that would have [approved / disapproved] of you avoiding driving through the floodwater?"	Elicit normative beliefs
"What were the factors that made it [easier / difficult] for you to avoid driving through the floodwater?"	Elicit control beliefs

Supplementary Table 2

Avoiding Driving Through Floodwater – Study 2: Theory of Planned Behaviour Global Measures and Control Variables

Variable	Item	Scoring or Rating	Scale Reliability
Intention	I intend to avoid driving through floodwater.	[1] *strongly disagree* to [7] *strongly agree*	Cronbach's Alpha = .66
	I plan to avoid driving through floodwater.	[1] *strongly disagree* to [7] *strongly agree*	
	I expect that I will avoid driving through floodwater.	[1] *strongly disagree* to [7] *strongly agree*	
Attitude	If I were to avoid driving through floodwater it would be:	[1] *bad* to [7] *good*	Cronbach's Alpha = .94
		[1] *negative* to [7] *positive*	
		[1] *unwise* to [7] *wise*	
Subjective Norms	Those people who are important to me think that I should avoid driving through floodwater.	[1] *strongly disagree* to [7] *strongly agree*	Cronbach's Alpha = .70
	The people in my life whose opinions I value would think that my choice to avoid driving through floodwater is desirable.	[1] *strongly disagree* to [7] *strongly agree*	
	Those people who are similar to me would avoid driving through floodwater.	[1] *strongly disagree* to [7] *strongly agree*	
	Most people like me would avoid driving through floodwater.	[1] *strongly disagree* to [7] *strongly agree*	
Perceived Behavioural Control	It is mostly up to me whether I avoid driving through floodwater.	[1] *strongly disagree* to [7] *strongly agree*	Cronbach's Alpha = .74
	I have complete control over whether I avoid driving through floodwater.	[1] *strongly disagree* to [7] *strongly agree*	
	It would be easy for me to avoid driving through floodwater.	[1] *strongly disagree* to [7] *strongly agree*	
	I am confident that I could avoid driving through floodwater.	[1] *strongly disagree* to [7] *strongly agree*	
Sex		[0] *male*, [1] *female*	-
Age		In years	-
Years Driving Experience		In years	-
Licence Class		[1] *learner*, [2] *red provisional plates*, [3] *green provisional plates*, [4] *open*	-
Past Behaviour (Extent Avoided)	To what extent have you avoided driving through floodwater?	[1] *small extent* to [7] *large extent*	*r*=.51, *p*<.001
	How often have you avoided driving through floodwater?	[1] *never* to [7] *very often*	
Times Driven Through	How many times have you driven through floodwater?	In number counts	-

Supplementary Table 3

Avoiding Driving Through Floodwater – Study 1: Summary of Interview Concepts, Key Themes, and Supporting Quotes of Behavioural, Normative, and Control Beliefs

Concept	Key themes	Supporting quotes
Behavioural Beliefs		
Advantages		
	Calculated decision process	"It was quite deep and quite fast, I think the uncertainty and potential danger of driving [through the floodwater] would outweigh the benefits of getting somewhere on time, so in that situation I would prefer to be late than to drive through the water." – *P16*.
		"I guess for me it was more we've always been raised to be quite sensible and I'd like to think I'm a sensible person so I would take a calculated risk." – *P10*.
	Didn't damage the car	"I wasn't going to get water coming through the door seals and wetting the carpet of my car." – *P09*.
		"The other part I was concerned about was damaging the car because and that might seem like a really strange thing to think about but for me there was a cost involved in that a financial cost if I ruined the car. As a you know year eleven year twelve student I was only working at Coles, wasn't earning a fortune." – *P10*.
	Safety first and foremost	"Myself as a person … it was more about myself and not putting myself in danger, that was the advantage of turning around." – *P21*.
		"It is always about personal safety and safety of others." – *P15*.
		"I had my little sister in the car and I will admit that that probably was a big contributing factor to my decision, because mum has always had this joke and tells every single person that ever gets in a car with us that's driving you know you're carrying precious cargo." – *P10*.
	Avoided feeling like an Idiot	"Well I didn't want anyone telling me, particularly my husband or someone, saying you're a bloody idiot for having done it." – *P12*.
		"Even just your reputation I guess a bit of embarrassment of it you got stuck in floodwaters it would be like you idiot you drove through floodwater." – *P18*.
		"You'll feel like an idiot because A you tried it and B you've lost your car and C you're on show to everyone there, they say 'is that your car is it?' And then you feel like a real idiot you have been named and shamed in front of everyone." – *P22*.
	Being a role model	"Being a role model for the kids as well." – *P12*.
		"By turning around or not going through it [floodwater] or waiting [for the water to subside] is demonstrating to others a sense of conscious thought, not to do that rather than just go ahead. People are like sheep all follow each other." – *P22*.
		"Probably demonstrated to people behind me that you know I wasn't prepared to take the risk and it might have made them think about it." – *P04*.
Disadvantages		
	Inconvenient (but not so terrible)	"The inconvenience wasn't so terrible that I wanted to risk it, in other words it added maybe fifteen or twenty minutes to my ride but that in itself wasn't enough to make me wanna go I can go for this." – *P07*.

	Negligible or non-existent disadvantages	"I was thinking about what route I would be able to take that wasn't flooded... I'd have to backtrack and go round and that was going to add another 15-20 minutes to my driving journey… and that would have delayed the bus that I could get, which meant I would have arrived at uni a good 40 minutes late... I ended up just turning around and going home."- P23. "It definitely [the nuisance of turning around] wasn't a big enough disadvantage to say well I'm going to keep driving through."- P10. "No, not one, there aren't any. I mean one could talk about not turning up at work. That's not a disadvantage, that's called staying alive... There's no disadvantage to waiting, to not going, none that are plausible or that have any sense of reasoning none, none that are good enough." - P22. "Personally I don't think there would have been any disadvantages, like I guess the only disadvantage would have been I would have got home quicker but it probably wouldn't have been the safest way of getting home." – P15.
Normative Beliefs Approve		
	Approval of important others	"I guess my family and friends but I think just local residence in general I think that's a pretty common view that its not safe to drive through floodwaters so I think it would be generally backed amongst most members of the city." – P21. "I guess we also knew too, when we got home the first question I was going to get asked by my Dad was 'how did you get home' and if he'd happened to get home before me and had gone the other way he'd or even worse if he'd come through after." – P10. "She kind of gave me a bit more respect [after making decision to not drive though] and realised that I was growing up and standing up for what I knew to be right." – P14.
	Everyone would approve	"I feel like just anyone in the general community around that area like no one wants to see anyone in trouble." – P08. "Well I would hope most people generally would approve of that decision and not even consider the alternative of driving through." – P19. "I can't imagine that people would really disapprove … I mean not when it comes down to your safety" –P01.
	Think of the rescuers	"The safety of the rescuers having to go and get them and you know that's a dangerous situation. These people are well trained to actually do that, but these people are risking life and limb to go out into sometimes raging floodwater to pull somebody back in, who basically had no business being there in the first place." – P20. "I mean what really sticks in my mind is sort of like the SES and the people that would go out and like help the people, they would always ask right at the end for people not to drive through floodwater so I suppose I would think about that as well." – P16. "For us it's the SES that gets called out to that sort of stuff you don't wanna put them in danger either because a lot of the time, especially where I'm from, the SES guys are the ones who get the most hurt because they're the ones who have to go out and rescue some idiot whose driven through." – P10.
Disapprove		
	Disapproval of other motorists	"I did feel a lot of pressure from the cars behind me to attempt it [crossing floodwater] and of course no one is speaking to me, but there's this kind of pressure." – P13. "I'm sure that there were a few people that were quite annoyed because it took me a few minutes to turn around and all of that and it disrupted that flow of one car from one side one car from the other, so you are always going to have those people that are just frustrated." – P10.
Control Beliefs		

Facilitators		
	Making plans and using existing plans	"Seeing the water, we stopped on the road on the hill put the hazard lights of the car on and because I was with my dad at the time as well I sort of had a discussion with him…that initial decision was quite quick, the rest of the conversation was where are we going to stay where are we going to go…more formulating a plan." – *P08*. "There was probably three or four other routes that I knew I'd be able to take because … it's quite hilly in that area so I knew that there would 100% be other options away from the river that I could take. So I guess if I wasn't familiar with the surroundings then it would have been a very different situation because I wouldn't have known how to get home." – *P21*. "In that circumstance we turned around and stayed the night in the town that we had come from rather than driving through the water because there was quite a significant amount of flooding on both roads." – *P08*. "I looked at the news reports and I decided that I would go anyway, so going down there was no problem but it continued to rain and we were there for like two days … I just thought look I've taken extra clothes and food and if we get stuck we get stuck and we will just stay here and wait it out." – *P20*.
	Experience, observation, and stories	"Having had that experience before of my car stalling and not being able to get out, I just said you know what I'm not going to risk it." – *P07*. "You know because I've been caught in floodwaters before myself and I've actually a friend of mine has died because of not doing the right thing so I'm very aware very aware." – *P07*. *"*I unfortunately had quite a few friends die in car accidents over a number of years … I think that myself and a couple of friends we realised that you know we weren't invincible and cars were quite dangerous… I was even more cautious of those conditions at the time and it was on my mind because it was very recent." – *P14*. "Her car stalled … so I just hesitated and I waited and then some men got out of cars and ran in and tried to help her and until she had stalled I was about to go." – *P04*. "As I was growing up my Mum would always tell this story about this kid she went to school with... they tried to drive through floodwater and the kid got drowned … I remember her telling us that many times when I was a kid and when you did encounter flooded roads that does come to mind." – *P17*.
	Environmental factors	"I have no idea about this area, about how deep or how far the floodwaters went, whether it would of gone deeper, whether it was faster flowing, even if it wasn't fast flowing there whether it would be fast flowing further in, and the extent of it so it would have been it was like an absolute nope because there were too many unknowns."- *P18*. "Depth and the also the speed of the water I think like if it's really fast flowing water you see on those ads and on the news people try and drive through really fast flowing water and you just see their car being taken in the other direction really quickly. So the speed of the water as well like if it was really really fast flowing definitely not." – *P16*. "I thought you know what there's nobody out here so if something did happen to me there nobody that can help me and save me. And I'm not excusing this but if you go through water on a free way and you did a big slide and sort of loose control of your car a little bit there's lots of other people around." – *P02*. "No we were the only people there, we sat there for a day and half and no one came through it … the thing is when you think about the outback the risk is greater compared to where it is in the city." – *P05*.
	Ill-equipped car	"I guess the fact I wasn't confident in my car at the time … being in a regular station wagon as opposed to a high set vehicle I just didn't feel comfortable that my car would make it through, like the other four-wheel drive and ute had done." – *P21*.

		"Whether or not depending on what your driving through what kind of track it is, tyres, you have got all the mod cons yeah you know you might drive through a higher risk situation if you have got a more modified car." – *P18*.
		"The fact that the other car went through it, I could clearly see that the other car was bigger than mine and heavier and that the sort of tyres it had on it were of a much higher grade than mine … I could clearly see it was of higher performance and better suited to do it … I took into account the difference in the cars." – *P09*.
		"If I was in another car then, I like I did have another car at that time, if I'd been in my other car I probably would have done it." - *P23*.
	Destination wasn't that important anyway	"The fact that where I was going wasn't, like it was necessary - it was something that I did every week, it was a class that I attended all the time but it wasn't something that I needed to be at. There wasn't that urgency there, there wasn't anyone depending on me to get there." – *P23*.
		"We only had a rough time to work to so it didn't have to be done that day it sort of could be done over several weeks, so we just we weren't pressured to be there at a certain time." – *P05*.
		"So in that situation you do have to get somewhere or if you have to get urgent medical help… that was interesting I've had to drive through flooded roads… in severe flooding once because I had to get to hospital." – *P20*.
Barriers	Other options are no better	"As far as making it more difficult I suppose being in an area that I didn't know in some ways it would have just been better to go through because I didn't know where I was going." – *P01*.
		*"*Just having to take a long way home I suppose time out of your day yeah or just getting lost actually with trying to find and alternate route and having no idea of where you are going." – *P18*.
		"The uncertainty this may have been both ways like I didn't know I thought well if I do turn around am I stuck is it going to get worse and I'll be stuck out for days or is it going to improve so if I just wait and you know or just try and drive through it isn't going to get any worse so yeah like it wasn't clear how long yeah it might be flooded for." – *P12*.
	Urgency to reach destination	"I felt pressure to get home because I knew my partner was waiting for me to be at home and he would expect me to be at home at a certain time and felt like pressure to get home to cook dinner and do the things that people do." – *P13*.
		"Having like the kids and the animals like having responsibility, yeah that wasn't just me I was making that decision about." – *P12*.
		*"*I think it was just an anxiousness about getting home yeah as though that would stop everything from happening you know, like once your home you're safe that kind of feeling." – *P04*.
	Fatigue	"Fatigue, I just wanted to go home to bed, it was something like five degrees, it felt like it was freezing so it was cold. I was tired." – *P11*.
		"You know you're tired and it's pouring down rain and you just wanna get home*" –P07*.

Supplementary Table 4

Avoiding Driving through Floodwater: Means (M), Standard Deviations (SD), and Bivariate Correlations between all Variables in the Model

	1	2	3	4	5	6	7	8	9	M (SD)
1. Intention	-	.25**	.05	-.05	.15*	-.23**	.33***	.49***	.46***	6.44 (0.85)
2. Sex		-	-.05	-.05	-.11	-.09	.00	.14*	.07	-
3. Years driving			-	.53***	-.05	.20**	-.04	.11	.07	7.51 (9.93)
4. Licence class				**-**	-.04	.15*	-.07	.02	.01	-
5. PB: Extent avoided					-	.01	.18*	.24**	.21**	4.99 (1.63)
6. Times driven through						-	-.14*	-.31***	-.20**	0.97 (1.69)
7. Attitude							-	.24**	.14*	6.53 (1.13)
8. Subjective norm								-	.51***	6.31 (0.79)
9. PBC									-	6.22 (0.82)

Note: PB = past behaviour, PBC = perceived behavioural control

Note: *p < .05; **p < .01; ***p < .001