Leveraging transport disruption to influence change

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Acknowledgements

Abbreviations and acronyms

Coronavirus-2019   COVID-19

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Executive summary

The goals of New Zealand's transport system are reflected in a range of policy documents which include the Ministry of Transport's Outcomes Framework, the Draft Government Policy on Land Transport 2020/21-2030/31, Arataki – Waka Kotahi's 10-year view of what is needed to deliver on government's priorities and objectives, the 'Road to Zero' Road safety strategy, and the recent Zero Carbon Act.

In New Zealand at the time of writing, the COVID-19 pandemic of 2020 had led to more than 1500 cases, 22 deaths, and a full lockdown of the country to minimise virus transmission. In so doing, it intensely disrupted many aspects of New Zealand life, from cancellation of social events and changing work and travel patterns, to job losses, closure of businesses, and mental health concerns. Despite the many negative outcomes, the notion of 'not wasting a good crisis' and leveraging disruptions as opportunities is present in popular culture, policy and academia. It suggests that learning from, and responding to, the disruption of COVID-19 could advance New Zealand's transport policy goals. However, disruptions are also a time of stress, uncertainty and unpredictability, raising questions about the appropriateness and effectiveness of attempting to facilitate policy and behaviour change at these times. Our transport system will play a key role in New Zealand's management of and recovery from the COVID-19 disruption. Therefore, in the short-term it is important to investigate how management and recovery could be achieved while advancing New Zealand's longer-term transport goals.

Research aims

The purpose of this literature review is to identify learnings from previous major transport disruptions to provide insight into how disruption can be leveraged to advance transport policy goals. The review focuses on the desired outcomes of New Zealand's transport system: inclusive access, healthy and safe people, economic prosperity, environmental sustainability, and resilience and security.

The specific objectives of this research are to:

1. Understand the effectiveness of using major transport disruption as the best time to influence behaviour change pertaining to transport.

2. Understand the relative merits of potential approaches to leverage the current transport disruption to influence behaviour change pertaining to transport.

Method

Based on the need for urgent government decision-making at this time, this is a rapid, targeted review of relevant literature, with the intention of informing government decisions as quickly as possible. This document is not a large-scale, systematic academic review. We take a system-view of 'transport behaviour', acknowledging the decisions and behaviour of individuals as well as elements in the physical and social environment, including the role of institutions and policy. The literature search of peer-reviewed academic and grey-literature published in the last 25 years focused on major travel disruptions (excluding COVID-19), which occurred during the last four decades, with a particular focus on the resultant behaviour and attitudinal change, and subsequent policy development/implementation. Key themes relevant to this study's objectives were distilled, and five case studies of disruptive events were developed to contextualise and support the findings. We have drawn on findings from the literature and case studies to identify key lessons that can inform potential approaches to advancing New Zealand's

transport policy goals. The discussion reflects on key themes from this review which may influence how government chooses to go about various action pathways.

Findings

Objective 1

Understand the effectiveness of using major transport disruption as the best time to influence behaviour change pertaining to transport.

There are a range of theoretical perspectives, including a socio-technical transition framework, resilience-thinking and behaviour change theories, which argue that disruptions provide a window of opportunity to learn, influence behaviour, re-examine processes and systems, foster niche innovations and ultimately advance policy goals. However, evidence of capitalising on major transport disruption to effectively influence transport behaviour change is considerably mixed, and studies examining long-term change are scarce. Despite this, the literature does offer some insight into the factors that may enhance the effectiveness of actions in the post-disruption period.

When a disruption occurs, people's travel behaviours change to adapt to the situation by changing mode, changing time of travel, not travelling, consolidating trips and changing destination. The type and extent of immediate behaviour change is highly related to the nature and longevity of the disruption. A few studies indicate that, in a small proportion of the population, transport disruptions alone can lead to long-term behaviour change or people being more open to the idea of change. However, in many cases following the resumption of 'normal' conditions, disruption-induced changes to transport behaviour eventually return to normal, especially if the underlying structures (social, economic and regulatory) remain as before with no concerted effort to foster long-term change.

This tells us that, unless there is a proactive response to identify and act on opportunities from the various disruptions of COVID-19, it is unlikely to have a lasting impact on people's transport perceptions and behaviour. In the literature we find that governments face strong pressure to restore pre-disaster conditions as quickly as possible, meaning proactive steps to make transformational changes are challenging. In addition, transport behaviour does not always change in the desired direction (eg reduction in public transport ridership after terrorist attacks) and opposing forces and conflicting interest groups may serve to entrench adverse outcomes, such as increased driving.

Although our case studies of previous disruptions present a mixed view, the experiences of disruptions such as the Christchurch Earthquake, London Olympics, Hurricanes Katrina and Rita and the Irish economic recession, do offer valuable lessons for how disruptions can become opportunities. In Christchurch, pre-disruption policies and groundwork for a more sustainable transport future provided an important bedrock for responsive plans after the earthquakes. Mobilisation of a network of local actors for engagement and transitional action were also crucial for both short-term activation and longer-term planning. Likewise, Ireland's pivot towards a sustainable transport direction amid an economic crisis demonstrates how efforts to create a sustainable transport system can be navigated in times of economic hardship if strong leadership can be coupled with public engagement.

Disruptions may also present opportunities to learn in more subtle ways, by reflecting on policy drivers and assumptions – which impact longer-term change – even if policy implementation is not immediately actioned. As seen in Hurricane Katrina, disruptions can be used to identify necessary improvements to institutional arrangements or ways of working such as disaster response strategies.

Objective 2

Understand the relative merits of potential approaches to leverage the current transport disruption to influence behaviour change pertaining to transport.

Drawing on the literature and case studies, we identified 10 key lessons or considerations which can help inform the approaches taken to advance New Zealand's transport policy goals during and post-COVID-19, as well as contribute to recovery strategies. Potential approaches can vary in the scale of ambition (ie mitigation to transformation), timing, and the transport behaviour or outcomes they target, specific details that will need to be further investigated. The critical point is not to go backwards – at the very least identify and mitigate the various forces that oppose transport goals (eg worsening road safety) or that attempt to entrench existing undesired norms (eg automobility).

- **Capture adaptations to and learning from** the COVID-19 disruption to-date and evaluate any associated policy response.

- **A clear vision or policy direction** prior to and immediately after the disruption will mean turning the disruption into an opportunity is much more likely. In New Zealand there are a range of policy documents which capture the vison of a safer, more inclusive, sustainable transport system. As a next step, a process of rapidly and proactively engaging with people at national and local levels of government (and possibly industry and communities) may help 'see', 'seize', and 'sustain' opportunities to advance the implementation of these transport policy goals, building on the lessons in this review. This seeing process will be important for identifying opportunities to support niche innovations and test ideas.

- **Proactively include vulnerable groups**: Several studies have highlighted that both the transport disruption itself and the policy response can disproportionately affect low-income groups, serving to create or reinforce inequalities. The needs of vulnerable groups must be central to the policy response and implementation. This is particularly important given the economic challenges arising from COVID-19. For example, initiatives to make public and active transport financially feasible, safer, easier and more attractive, to support inclusive access among vulnerable users are worthy of investigation.

- **Leadership, communication, and engagement**: strong leadership coupled with public engagement and clear communication is extremely important in the disruption and post-disruption period, including in times of economic hardship. This needs to strike a balance between government-led decisions and public voice and citizen-led innovations.

- **Mitigate the impact of opposing forces and negative consequences**: during and post-COVID-19, specific strategies may be needed to mitigate increases in driving and unnecessary reductions in public transport, which also have implications for safety. Preventing further negative outcomes such as these is needed prior to, or alongside examining opportunities to advance policy goals.

- **Understand transport-related perceptions, behaviour, and broader socio-cultural conditions to help guide the timing and type of approach**: in addition to the nature and scale of the disruption, socio-cultural factors such as public distrust and levels of uncertainty and stress should be examined.

- **Adapt the approach to the target group or context**: fostering behaviour change in individuals or organisations who were already contemplating or showing some desire to change may be a useful component of the overall response. This focus should be in combination with a focus on vulnerable groups who may have no capacity to change or who have limited/constrained transport options.

- **Synergy between transport, disruption recovery, and broader societal goals**: identifying transport solutions and opportunities which align closely with COVID-19 management and recovery and broader societal goals is important, particularly in times of economic hardship. For example, policies that encourage walking and cycling (eg walking and cycling infrastructure, bike parking and end of trip facilities) can have multiple benefits, including improving access to employment, essential services and health and wellbeing in a time of stress, while also enabling physical distancing Comprehensive speed management regimes could improve safety, the quality of local environments, and support walking and cycling and local commerce.

- **Resilience, a multimodal transport system and land-use**: developing a transport system that provides a variety of transport options can reduce the impact of a disruption, including any future COVID-19 outbreaks, as well as align with environmental, health, safety and inclusivity goals. This link between future resilience and a range of transport options could be a way to garner support from businesses and the public for a more multimodal New Zealand after the experience of COVID-19.

- **A potential focus on reduced travel**: previous disruptions such as the volcanic eruption of Eyjafjallajökull in Iceland in 2010 have highlighted society's 'hyper' mobility and suggest that a reduction in overall travel also needs to be considered in efforts to combat issues such as climate change and road safety. It is worthwhile considering how reduced travel (eg encouraging work from home practices) could be a future transport policy goal and if it is possible to align this approach with on-going COVID-19 management, economic recovery and inclusivity goals.

Research suggests it is important to work quickly to identify and plan for leveraging opportunities, but careful timing is needed around leveraging activities following initial transport practices directly related to managing the disruption. The time when the immediate threat of the disruption, including great stress, uncertainty and focus on basic needs, has passed for most but when different mobility experiences are still proximal to people's memory, may represent a fertile time for re-visioning, learning from experimenting and actioning policy. Transport behaviours following the first outbreak of COVID-19 may have returned to the status quo, and while this may mean some opportunities have been missed it does not close the door completely, especially for system-level changes as the COVID-19 experience continues. Similarly, as New Zealand continues to deal with COVID-19, the disruption caused by economic recession is also likely to linger, meaning that there are opportunities to combine economic recovery with advancing transport goals.

Conclusion

Transport disruptions are an opportunity to advance policy goals and contribute to long-term transport behaviour change. However, this will not automatically happen - a careful, fine-grained system-level sustained response is needed, one that rapidly and proactively identifies and acts on opportunities at the right time. A range of approaches are possible with differing levels of ambition, and New Zealand's existing policy direction for safe, sustainable and inclusive transport already provides a strong platform for change. Lessons from previous disruptions show that New Zealand may be more successful at turning COVID-19 into an opportunity if we can balance strong government leadership with proactive community engagement, especially vulnerable groups, and quickly identify transport solutions which have synergy with economic recovery, safety and health, inclusivity, climate change and resilience goals.

The critical point is not to go backwards, at the very least, the various forces attempting to embed the status quo of negative outcomes such as poor road safety and entrenched automobility should be identified and mitigated. In addition, it should be ensured that the disruption and/or the policy responses do not further disadvantage vulnerable groups.

The disruption of COVID-19 is on-going and will not be New Zealand's last disruption, particularly as climate change accelerates. Therefore, learning from this experience provides a chance to act now, but also to enhance resilience to future disruptions, in a way that reflects our transport policy goals.

Abstract

The COVID-19 pandemic has intensely disrupted many aspects of travel patterns and behaviours in New Zealand. This literature review examined academic and grey literature of previous disruptive events from around the world with a focus on behaviour change and policy developments. The aim of the review was to identify the value of leveraging transport policy change from a disruption and to understand potential approaches. The review found that people's travel behaviours rapidly change to adapt to a disruptive situation, with the type and extent of behaviour change being directly related to the nature and longevity of the disruption. In most cases, once 'normal' conditions resume so too do pre-existing travel behaviours, particularly if there is no change to underlying conditions or a concerted effort to foster long-term change. Transport disruptions can be opportunities to advance policy goals and contribute to long-term transport behaviour change. To achieve this, the literature suggests that a careful, fine-grained system-level response is needed, which rapidly and proactively identifies and acts on appropriate opportunities at the right time. We have identified 10 key lessons or considerations, which can help inform the approaches taken to advance New Zealand's transport policy goals in the context of COVID-19. Key examples include: a clear vision for the disruption and post-disruption response leveraging existing policy, proactive engagement with vulnerable groups, balancing strong government leadership with community engagement, and synergy between transport solutions, economic recovery, safety and health, inclusivity, climate change and resilience goals. Most importantly, don't go backwards.

1   Introduction

1.1   The context

Our transport system is central to population wellbeing and the liveability of places (Ministry of Transport, 2018; NZ Government, 2020). The Ministry of Transport describes five interconnected outcomes for New Zealand's transport system (figure 1.1), which underpin this overall goal: inclusive access, healthy and safe people, economic prosperity, environmental sustainability, and resilience and security (Ministry of Transport, 2018).

Figure 1.1   Outcomes for the transport system (Ministry of Transport, 2018)

Inclusive access
Enabling all people to participate in society through access to social and economic opportunities, such as work, education, and healthcare.

Healthy and safe people
Protecting people from transport-related injuries and harmful pollution, and making active travel an attractive option.

Economic prosperity
Supporting economic activity via local, regional, and international connections, with efficient movements of people and products.

A transport system that improves wellbeing and liveability

Environmental sustainability
Transitioning to net zero carbon emissions, and maintaining or improving biodiversity, water quality, and air quality.

Resilience and security
Minimising and managing the risks from natural and human-made hazards, anticipating and adapting to emerging threats, and recovering effectively from disruptive events.

Draft Policy Statement for Transport 20/21-30/31 outlines four strategic priorities: safety, better travel options, improving freight connections, and climate change (NZ Government, 2020).

A transition to increased active and public transport coupled with reduced car use is fundamental to achieving this goal (Waka Kotahi NZ Transport Agency, 2019), as is ensuring fair and equitable access to employment and social opportunities. New Zealand's Road to Zero road safety strategy is also central to New Zealand's transport goals (NZ Government, 2019) and the recent Climate Change Response (Zero Carbon) Amendment Act (Ministry for the Environment, 2019) underscores the urgent need to decarbonise our transport system.

Over and above the ill-health caused directly by the COVID-19 pandemic, this event has intensely disrupted many aspects of New Zealand life. Consequences include cancellation of social events and changing travel behaviours, job losses, closure of businesses and the mental health effects of isolation and uncertainty. Major disruptions like this provide a context that stimulates consideration of new ways of doing things in all areas of life. For transport systems, empty roads have led to the mass experience of car-free walking and cycling, and requirements to work from home for non-essential workers has reduced

overall travel. Is it possible to lever off these experiences to advance more sustainable, safer and inclusive transport as desired through current policy?

Public transport patronage has reduced in response to concerns about COVID-19 transmission and safety procedures. Fuel and car prices have also dropped, and parking charges have been reduced in places. Likewise, people are dealing with job losses or a change in circumstances. These impacts of the COVID-19 disruption suggest that action to advance some aspects of transport policy may be difficult. But also, action may be required to ensure these impacts do not result in lasting reductions in public and active transport or poorer safety outcomes.

The government's core challenge is to address immediate public health and economic concerns, while proactively identifying lessons from COVID-19 which could advance progress towards climate change, public health and long-term aspirations for transport. Historically, there are examples of how large-scale disruptions, such as war and natural disasters, have provided a context and desire for social change and advancement. With this in mind, we explore whether this is a good time to be acting on longer-term goals and, if so, what can be learned from previous transport disruptions. We also examine how governments have responded in order to optimise both the immediate response, but also leverage the experience to advance transport policy goals.

It is likely that acute disruptions to our transport system will occur more frequently in years to come through extreme weather patterns, other pandemics and rising sea levels. Therefore, learning from COVID-19 is an opportunity to help New Zealand adapt to accelerating climate change.

This work recognises the bicultural foundations of New Zealand through Te Tiriti o Waitangi, and the requirement of transport policy to engage with, reflect the needs of, and promote the aspirations of Māori. This goes hand in hand with the inclusivity goals outlined in the draft Government Policy Statement on Transport (NZ Government, 2020), Waka Kotahi's Te Ara Kotahi Māori Strategy (Waka Kotahi, 2019), and Vision Mātauranga principles (Ministry of Business Innovation & Employment, 2020).

1.2   Research aims

The purpose of this research is to capture the lessons from previous major travel disruptions to understand the effectiveness of using the transport disruption from COVID-19 as an opportunity to influence change, with a focus on the desired outcomes of New Zealand's transport system: inclusive access, healthy and safe people, economic prosperity, environmental sustainability, and resilience and security (Ministry of Transport, 2018).

The objectives of this research are to:

1) Understand the effectiveness of using major transport disruption as the best time to influence behaviour change pertaining to transport.

2) Understand the relative merits of potential approaches to leverage the current transport disruption to influence behaviour change pertaining to transport.

Insights and evidence from this research will assist decision makers in central government, Waka Kotahi, Ministry of Transport, and local government to:

- plan recovery actions

- prepare for future pandemic threats and other potential disruptions

- progress towards a more sustainable, safer and inclusive transport system.

This is a rapid, targeted review of relevant literature, with the intention of informing government decisions as quickly as possible. This document is not a large-scale, systematic academic review.

1.3   Defining transport disruption

Disruptive events are defined as those that impact the supply or demand of transport (either infrastructure or services), the cost of using transport or a combination of these factors (Marsden and Docherty, 2013).

Transport disruption can:

- impact particular groups, a geographical region or a whole population

- be planned disruptions, such as a major sporting event or construction project

- result from unexpected events, such as flooding, earthquakes, transport worker strikes, health pandemics or oil crises, and

- vary in scale and longevity, from a temporary bridge closure to a major earthquake.

In major disruptions such as earthquakes, flooding, health pandemics and war, transport disruption is part of a wider crisis, where many other aspects of life are also being disrupted.

Disruptive events have typically been framed as a negative phenomenon. However, more recently technological developments (eg autonomous vehicles) have also been described as 'disruptive', with a more positive framing of learning, progress and innovation. In this report we focus on past disruptions rather than potential future technological disruptions but apply this positive lens of what can be learned.

In this review we refer to the phases of 'pre-disruption', 'disruption' and 'post-disruption'. However, it is important to acknowledge the varying dynamics that are occurring within these broad phases which are dependent upon the nature of the event (Loo and Leung, 2017). For example, the disruption phase may be characterised by an initial period of chaos and confusion, followed by temporary behavioural adaptations and lingering uncertainty. Likewise, the post-disruption period may represent a complete return to normality or there may be a need for an immediate response, a long-term recovery period and long-term behavioural adaptations (Loo and Leung, 2017).

2   Method

We completed a Google Scholar search of peer-reviewed literature published in the last 25 years. Google Scholar is a comprehensive literature database and we deliberately used a range of search terms to ensure we identified as much relevant literature as feasible within the timeframe of this review. The scope of the literature review included behaviour change and attitudinal research, and policy development/implementation literature related to major travel disruptions (excluding COVID-19), which occurred during the last four decades. While the focus was on land transport, this did not preclude disruptions that primarily impacted aviation or sea transport where learning from those disruptions was applicable.

Search terms focused on how disruption may affect transport policy and behaviour, including theoretical underpinnings and reactions to key past disruptions. Examples of search terms are below. A full list is provided in Appendix A.

- Disruption to transport systems effect on public policy.

- Reaction to learning from transport disaster.

- London Olympics transport disruption behaviour change.

- Weather disruption on transport policy change Florida.

We prioritised literature that provided the closest fit with addressing the research objectives. The primary area of focus was literature related to long-term behaviour change and policy responses following disruptive events to transport systems. Of secondary interest was identifying lessons from disruptions that caused an immediate impact on travel patterns, but where no successful attempt to change the transport status quo was evident.

First, we distilled key themes from the literature that were relevant to the objectives. Second, we outlined five case studies of disruptive events. Literature on these case studies was used to explore the research questions within a more contextual setting. Case studies represent a range of experiences, from proactive attempts to change travel behaviour following the disruption to examples of what happens when no proactive steps are taken. For these case studies, we also reviewed grey literature where necessary.

3 Findings

3.1 Theoretical perspectives: influences on transport behaviour and disruptions as opportunities

This review focuses on transport behaviour and leveraging change. Therefore, we need to briefly describe theoretical perspectives which conceptualise various influences on transport behaviour and pathways to change at a system-level and an individual level.

3.1.1 Socio-technical framework and transition

Transport systems are complex. They do not appear as isolated infrastructure alone. A useful way to understand and visualise transport systems is through Socio-Technical Systems theory, which recognises the complex, dynamic nature of systems and the cross-directional influences of numerous contexts and relationships (eg social, institutional, political, culture, infrastructure, technology and economic) that influence outcomes (Geels et al., 2017; Rasmussen, 1997; Vreugdenhil and Williams, 2013). Socio-technical systems can take many decades to develop, and as different elements align and build on each other they create in-built dependencies with rules and actions becoming deeply entrenched. This leads to a change-resistant 'socio-technical regime' (Geels et al., 2017). In the case of the transport system in many countries, including New Zealand, the regime of automobility is firmly entrenched. It is maintained by institutional programmes which focus on the prioritisation of delivering roading infrastructure for private vehicles; the assumptions underpinning transport planning; the preferences and habits of car drivers; the cultural associations reinforced through the media of car-based mobility being equated with freedom and individual identity; permissive vehicle import laws; and regulations and policies such as petrol taxes, traffic rules, and parking fees (Geels et al., 2017; Hebbert, 2005).

The socio-technical system can be used not only to understand how a system regime is built, reinforced and entrenched, but also what aspects of the system need to be targeted to promote a transition away from a dominant regime. The multi-level perspective is a transition framework that helps to describe change within socio-technical systems. It posits that transitions occur through the interaction between the three levels of the system: niche innovations, socio-technical regimes, and the socio-technical landscape (Geels et al., 2017; Rip and Kemp, 1998). In the case of providing transitions away from the regime of automobility: a niche innovation may include demonstration projects; the regime includes dominant rules, organisations and structures which maintain the existing system; and the landscape is the socio-economic context in which everyday people live. For a visualisation of the socio-technical system transition pathway, see Appendix B.

Exogenous factors in the socio-technical landscape can also place pressure on the current regime of automobility, providing an opportunity for niche innovations to develop. These exogenous factors can be gradual societal trends or shocks or disruptions such as war, accidents, political upheaval and economic crises (Geels et al., 2017). Within this framework, disruptions such as COVID-19 and others can be seen as a window of opportunity to challenge this system of automobility and potentially pave the way for niche innovations.

3.1.2 Behaviour change theories

A range of other theories describe an individual's pathway to behaviour change (Glanz et al., 2008). For example, the Transtheoretical model includes constructs such as stages of change, processes of change, levels of change, self-efficacy, and decisional balance (Prochaska et al., 2008). Turning points in life (eg a

new job, school, or house), and possibly transport disruptions, can be seen as 'consciousness-raising', encouraging some people to reflect on their existing behaviour and to consider the possibility of change i.e. moving to a contemplation stage.

Individual behaviour change theories are too narrow on their own to understand complex system dynamics. These theories also typically focus on the actions of idealised consumers: seldom is attention paid to individuals or institutions who produce or control choice. For these reasons we have taken a broad approach in the review, drawing on a variety of theoretical frameworks.

3.1.3 Disruptions as learning

Marsden et al's (2020) transport policy research draws on sociology of disruptions literature (Graham and Thrift, 2007; Vollmer, 2010) to argue that studying transport disruptions allows exploration of what is necessary to achieve change by drawing out and challenging existing norms and assumptions that underpin systems. Responses observed during disruptions may not necessarily lead to change per se, rather it is the learning from adaptation during disruption that can be used to develop new approaches and reconfigure transport systems (Marsden et al., 2020)

This perspective also emphasises the need to focus on how disruptions influence social norms and expectations within individuals and institutions, not just individual behaviours. In addition, the traditional framing of transport behaviour as stable and difficult to change may miss opportunities to learn from everyday disruptions (Marsden et al., 2020; Marsden and Docherty, 2013). If disruptions and change are acknowledged as a part of everyday life, proactively learning from these instances can become embedded, a concept described in the following quote:

> *when things break down, new solutions may be invented. Indeed, there is some evidence to suggest that this kind of piece-by-piece adaptation is a leading cause of innovation, acting as a continuous feedback loop of experimentation which, through many small increments in practical knowledge, can produce large changes* (Graham and Thrift, 2007, p5).

This way of thinking is consistent with concepts in tactical urbanism and innovative temporary street installations, whereby disruption is seen as an opportunity to learn and then adapt (Lydon and Garcia, 2015).

3.1.4 Resilience thinking

The concept of learning through disruption is also present in resilience definitions and frameworks in transport and sustainability fields (Folke et al., 2002; Wang, 2015). This type of 'resilience-thinking' focuses not only on building back to pre-disruption conditions but also learning, adapting, or transforming to a new and improved state (Wang, 2015).

3.1.5 Summary

Taken together, these complementary framings mean that, when researching the opportunities to change transport behaviour against the backdrop of disruption, we need to consider a range of socio-technical influences, and the various policy levers and actors involved. Further, considering whereabouts on the pathway to transport behaviour change individuals or groups are may also be important.

The literature and frameworks above demonstrate that disruptions present a window of opportunity to learn, re-examine processes and systems, foster niche innovations and advance policy goals. This does not discount the harm, often severe and widespread, that disruptions can cause, but rather acknowledges

that unfortunate and unforeseen events may be leveraged to create societal benefits. Further, while the time after a disaster presents obvious opportunities to reconstruct in a more sustainable pattern, the challenge is that this is also the moment where populations feel most vulnerable and potentially distrustful of efforts to restructure communities (Hirsch and Levert, 2009). There may be a myriad of factors following a disruption which exacerbate hardship, flatten motivation, and destroy opportunity, thus serving to embed the status quo (Kates et al., 2006; Wiek et al., 2015). Similarly, there is an important distinction between voluntary change to travel patterns and improved access to life-enhancing opportunities, versus forced change due to having no option or choice.

In the next sections we explore if and how disruptions have been used as opportunities, broader considerations that may enhance effectiveness and who tend to be the winners and losers in these efforts.

3.2 Behaviour change and transport disruption in practice

In examining the impacts and opportunities of disruption we focus on both:

- the impact of disruption on perceptions and behaviours of members of the general population, and

- the impact of disruption on the policies and decisions made by individuals and groups in governments and other institutions (ie the leveraging opportunity), and the resulting impact on long-term transport behaviour. This also considers how a disruption can be leveraged as an opportunity when there are already some conditions and policies in place to support the desired policy direction. In addition, how governments and organisations mitigate the effect of opposing forces and, at bare minimum, retain the status quo following a disruption is also an important question.

In Sections 3.2.1 and 3.2.2 we briefly summarise key points from the literature from these two focus areas. Case studies in Section 3.3 contextualise these key points through specific examples of transport disruption.

3.2.1 Impact of disruption on 'people's' perceptions and behaviour

When a disruption occurs, people's travel behaviours change to adapt to the situation. These 'adaptive capacities' include changing mode, changing time of travel, not travelling (working from home), consolidating trips, and changing destinations (Marsden et al., 2020; Masud, 2019; Polak et al., 2001; Vollmer, 2010). It has been suggested that people's ability to adapt is more flexible than previously thought (Cairns et al., 2002; Graham, 2010; Marsden et al., 2020). An individual's travel patterns are not necessarily stable or fixed, with some level of flexibility or adaptation occurring in everyday life (Cairns et al., 2002; Marsden et al., 2020). Therefore, a disruptive event can introduce a greater need to deploy these adaptative strategies, and while not necessarily leading to long-term behaviour change, can offer learning about the nature of adaptation and where long-term change may be possible (Marsden et al., 2020). Socio-cultural factors, such as a society's level of resilience and capacity to cope, may also affect how people react to disruptions more generally, and therefore how governments prepare and respond (Trentmann, 2009).

The type and extent of behaviour change is highly related to the nature and longevity of the disruption. For example, if parts of the physical transport system become unavailable (ie bridge collapse, flood damage, earthquake damage etc) then behaviour will be significantly affected for the duration of the disruption (Zhu et al., 2010). Following the resumption of normal conditions, evidence of behaviour change seen in the wake of the disruption – the transient phase – also returns to normal. Conversely, non-infrastructure disruptions (ie financial crash, epidemic, terrorism, public transport strike) rely not on

re-building infrastructure, but on the restoration of a broader set of conditions including the rebuilding of public trust, mitigation of fear, and economic stimuli. It has been suggested that behaviour change stemming from these types of disruption may be impacted for longer, but in more subtle ways (Hirsch et al., 2016; Jahoda et al., cited in Trentmann, 2009; Polak et al., 2001; Wang, 2014). For both disruption types, the research suggests that unless there is a dedicated effort to foster long-term change, behaviours eventually revert to normal or in some cases may regress. Some examples are presented below.

- *Permanent loss of public transport ridership after strikes or repairs* has been reported by numerous sources. For example, after the 1981 and 1986 Orange County transit strike, a 20% decrease in ridership was reported from the market share of 2% (Ferguson, 1992). Similarly, a study of the 2016-2017 repairs to the Washington DC metro system found that 20% of survey respondents did not go back to using the system after it was fully restored (Masud, 2019).

- *Bridge collapses* affect usage rates initially, but once they are restored, traffic quickly returns. The 1994 Northridge Earthquake in the US resulted in a collapsed bridge. Once 70% of its capacity was restored, traffic volume increased to 88% of pre-earthquake levels, and after full capacity was restored, total traffic increased and went beyond the pre-collapse level (Zhu and Levinson, 2008). Likewise, after 70% capacity of the I-5 bridge in California was restored, 88% of traffic returned (Zhu et al., 2010)

- *The SARS epidemic* in 2003 resulted in rapid decreases in public transport ridership in several Asian countries, but which quickly returned to normal levels. In Taiwan, the concept of 'fresh fear' was described, with each reported SARS case being directly linked to the immediate loss of 1200 underground passengers. Eventually, ridership returned to normal with the only long-term behavioural change being the carrying of masks (Wang, 2014). Similar findings were reported in Wuhan with the predominant ongoing behaviour change not being ridership rates, but the more regular washing of hands (Tan et al., 2004).

- When people are forced to experiment with habitual travel patterns because of an external force (e.g. the London two-day London tube strike in 2014) there may be small but lasting impacts on travel behaviour. Therefore, small-scale 'nudge' experimentations or disruptions, such as those often used in tactical urbanism, might mimic this mechanism (Larcom et al., 2015).

There is a risk that shifts to increased driving, because of a transport disruption, can also adversely impact safety. The most notable example is the September 11 terrorist attack, where concerns about the risks of air travel meant a portion of Americans substituted flying with interstate driving for approximately one year, resulting in increased traffic fatalities estimated at an additional 1,500 deaths (Gigerenzer, 2006). Although reductions in public transport behaviour may, in most cases, eventually recover, this potential negative impact on safety, as well as risks of social exclusion for groups who rely on public transport, highlights the need to restore (if not enhance) ridership as quickly as possible.

Cycling has often been used as part of the emergency response, and as part of an alternative transport mode. Examples from a variety of disruptions include:

- *Emergency response*: As part of the immediate disaster response, 'citizen bicyclists', especially using cargo bicycles, deliver goods and transport people. Examples have been reported in New York as a response to the September 11 attacks (Kirkpatrick, 2018) and in a number of states in the USA following the 2012 Superstorm Sandy (Page, 2014). Likewise, after the 1995 Hanshin earthquake in Kobe, Japan, parts of the city were only accessible to emergency responders on bicycle (Page, 2014).

- *Short-term alternative transport mode*: In 2011 in the aftermath of the Tōhoku earthquake, Tokyo commuters bought bicycles to get home because train services were shut down and roads were in gridlock (Kirkpatrick, 2018). A tube strike in London in 2015 also resulted in an increase of bicycle trips by 85% during the strike, with numbers immediately returning to pre-strike rates after it was over (Saberi et al., 2018).

- *Medium-term alternative transport mode*: After the London bombings people were fearful of using the underground and there was a spike in the use of bicycles for several months afterwards (Fasolo et al., 2008).

- *Long-term alternative transport mode*: In Sri Lanka, bicycles were given to some of the 2005 tsunami survivors so they could better access services and their livelihoods (World Bicycle Relief, 2018).

Note that across the literature there is a need for more longitudinal studies of behaviour change and/or predilections for new behaviours in populations following disruptions. A limitation of many of the studies included is that their definition of long-term was generally no more than two years past the disruptive event. Likewise, a lack of pre-post studies means there is a high reliance on recall of behavioural adaptations following disruptions (Marsden et al., 2020).

3.2.2   Leveraging disruptions to influence change – governments and institutions

Based on our reading and interpretation of the literature, the overall theme in government responses is that governments and institutions end up focusing on restoring pre-disaster conditions as quickly as possible, with limited proactive steps to leverage a disruption to influence change. However, there are exceptions, and complexities to this pathway. By examining literature of previous transport disruptions, we have identified key lessons, including factors which make it easier or harder to leverage disruption as an opportunity. These factors are summarised below and explored in more depth in sections 3.3 and 3.4. Identifying learning from disruptive events is challenging because there is a lack of studies investigating this issue and, as noted by Marsden et al (2020), the unanticipated nature of some disruptions may mean there are difficulties mobilising resources to understand these events when the institutional focus is on response and recovery.

The nature of the disruption

The nature, scale and longevity of the disruption is an important influencing factor (Birkmann et al., 2010). There are examples where disruptions have led to various levels of transport policy reform and implementation; however, this is mostly in cases where a major physical disruption (eg earthquake) (Brundiers, 2018) or severe economic recession (Piercy et al., 2010; Rau et al., 2016) has provided a strong impetus for governments to re-examine their transport system alongside broader urban planning, social and economic goals. However, even in severe disruptions path-dependent rebuild processes can occur, serving to restore the status quo (Wiek et al., 2015). Following smaller disruptions such as transportation strikes and terror attacks, while people may be required to make short-term adaptations, the disruption may do little to foster an appetite for policy change.

From a socio-technical transition perspective, smaller disruptions (both in scale and temporality) can fail to place pressure on the current regime or foster niche innovations (Geels et al., 2017). Even in the case of large planned disruptions, such as the Olympics, the opportunities for policy and institutional change are not straight forward or inevitable (Mulley and Moutou, 2014).

Pre-disruption conditions and directions

The pre-disruption conditions and policy direction are important. It may be easier to leverage disruption as an opportunity if there is already a level of support for the desired direction (Brundiers, 2018; Rau et al., 2016). This may mean the post-disruption response accelerates the existing vision or revitalises plans rather than introduces new ones (Marsden et al., 2020).

This consideration of pre-disruption conditions is also relevant on an individual or organisation scale. For example, the experiences of the London Olympics suggest that fostering behaviour change following or during a disruption may need to be targeted at individuals or organisations who are contemplating or already showing some desire to change, not simply those that were forced to make a short-term adaptation (Parkes et al., 2016).

Opposing forces, conflicting interests, and adverse outcomes

Conditions and factors in the disruption or post-disruption period can also have adverse outcomes, and influence policies and change in the undesired direction, referred to as opposing forces or conflicting interests. For example, new parties or actors may become involved in the reconstruction of affected regions and attempt to capitalise on the disruption for their own gain (Birkmann et al., 2010; Wiek et al., 2015). The media may also play a role in spreading and reinforcing fear following terror attacks on public transport systems (Litman, 2005). Likewise, disruptions to public transport systems, such as terrorist attacks, may lead to substitution of public transport behaviour with driving if there is a lack of alternative transport options (Fasolo et al., 2008; Litman, 2005; López-Rousseau, 2005). Based on the literature, most of the effort from governments has focused on mitigating these opposing forces rather than attempting to leverage further change. Examples of mitigating strategies include fully subsided fares for public transport, fare reductions or changes to services in the post-disruption period, and public communication strategies (Ferguson, 1992; Litman, 2005; Snyder, 2018). A recent example of an opposing force from New Zealand is provided in figure 3.1.

A good example of how a previous transport disruption impacted road safety policy is the 1973 oil crisis, where the American federal government restricted speed limits to 55 miles per hour on interstate roads with the aim of reducing fuel consumption (Friedman et al., 2009). In the following year, road fatalities dropped by 16.4%. However, the speed limit legislation was removed in 1995, and this is attributed to a 3.2% increase in fatalities in the next 10-years. Authors note the broader benefits of reduced speed limits, of reduced gas consumption and air pollutants alongside the safety benefits (Friedman et al., 2009).

There is strong evidence that links times of economic recession and unemployment with fewer road fatalities (He, 2016; Wegman et al., 2017). Research attributes this relationship primarily to changes in travel patterns and behaviour, for example reduction of driving among high-risk young drivers and fewer crashes involving commercial trucks and high speeds (He, 2016; Wegman et al., 2017). While unemployment and economic recession are not desirable outcomes, there may be opportunities to improve safe and sustainable mobility for unemployed people as part of pathways to employment and economic recovery.

Timing

Several studies have discussed the importance of responding quickly in the post-disruption period, as enthusiasm can dissipate within institutions and the public (Birkland, 2006; Mulley and Moutou, 2014; Surjan and Shaw, 2008). Rather than specific guidance on time periods, Brundiers (2018) describes the appropriate phases as 'seeing', 'seizing', and 'sustaining' actions, with different capabilities and resources needed in each phase. This is discussed further in the Christchurch Earthquake case study (section 3.3.1)

Leadership and engagement

Strong leadership and resourcing, backed by a clear vision, is important for leveraging opportunities for change (Piercy et al., 2010; Rau et al., 2016). This must be coupled long-term with strong public engagement and involvement (Brundiers, 2018; Nakanishi and Black, 2016; Wiek et al., 2015). In addition, disrupted travel perceptions and behaviour (eg fear of using public transport), public distrust and uncertainty can be heightened following major disasters (Brand and Seidman, 2012; Hirsch and Levert, 2009). More authoritarian-type decision-making, which is often effective in managing severe disruptions initially, may undermine community resilience and voice (Imperiale and Vanclay, 2016). Conversely, times of disruption can lead to more informal self-organisation in communities (Birkmann et al., 2010; Imperiale and Vanclay, 2016), which may provide opportunities for niche innovations. This literature suggests that understanding public perceptions and behaviour in relation to transport, but also to broader concepts such as government trust (Hirsch and Levert, 2009), and skilfully engaging the community (Nakanishi and Black, 2016) are important components of the post-disruption period. Likewise, understanding where there may be appetite for or capacity to change, be it in a street, a community, a workplace or a region, may help guide prioritisation of effort.

Disproportionate impact on low-income groups

Several studies have highlighted that transport disruption can disproportionately affect low-income or groups because they often have fewer options and capacity to adapt (Hirsch et al., 2016; Marsden et al., 2020; Masud, 2019). They may be unable to work from home or be reliant on public transport (Hirsch et al., 2016; Kontou et al., 2017; Masud, 2019). However, the disruption response policies and initiatives may also serve to create or reinforce inequalities if their needs are not central to the vision and community engagement activities (Birkmann et al., 2010; Pereira et al., 2019; Snyder, 2018; Zhou et al., 2018).

Disruptions and learning

Marsden and colleagues (Marsden and Docherty, 2013; Marsden et al., 2020) argue that disruptions may not necessarily provide policy solutions, but draw out assumptions, stimulate learning, and bump the social system into a new place. In line with this, considerable literature has emphasised how disruptions have demonstrated the synergy between resilience and sustainability goals – a multi-modal system is also a resilient system, because multiple options for the same trip mean there is less risk of complete immobility during times of breakdown (Amdal and Swigart, 2010; Litman, 2005). Disruptions such as the volcanic eruption of Eyjafjallajökull in Iceland in 2010 have highlighted society's hyper mobility and suggest that a reduction in overall travel also needs to be considered in efforts to combat global challenges such as climate change (Britchnell and Buscher, 2011; Marsden et al., 2020; Urry, 2004). Further, researchers have also suggested using land use and transport planning to support 'localism' and reduce overall mobility to deal with future disruptions, overcome environmental problems, and promote resilience (Ferreira et al., 2017). While these are not specific policy actions taken by governments after a disaster, such considerations are very pertinent to transport policy goals and provide another dimension to learning through disruption.

Figure 3.1 An example of an 'opposing force' in a New Zealand newspaper, March 2020

3.3　Case studies

The following case studies provide examples of how a range of events, planned and unplanned, have disrupted travel, and whether governments and other stakeholders have seized the opportunity to advance longer-term transport objectives. Any longer-term changes in transport behaviour from the disruption, if there were any, are also discussed.

Each case study tells a slightly different story, providing a different lesson. We have provided a more detailed account of those case studies that are highly relevant to the research objectives. We have organised conclusions from the literature into the following key points (depending on the availability of relevant literature) but with customised headings as appropriate to each case study:

- the nature of the disruption

- immediate impacts on travel behaviour

- associated policy changes and impact on longer-term behaviour change

- similarities and differences to the New Zealand context

- the timing of policy actions during and after the disruption, and how timing relates to effectiveness (eg critical actions), and

- any successes or failures in terms of policy responses.

3.3.1　Christchurch earthquake

Immediate impacts

In 2010/11, major earthquakes in Canterbury led to 185 deaths, significant traumatic injury and widespread damage to the city centre and surrounding infrastructure including services, roads and buildings (Potter et al., 2015). In the immediate aftermath there were widespread impacts on transport infrastructure and travel behaviour (Koorey, 2018). Roads were damaged, freight routes were disrupted, and destroyed property meant travel destinations were removed. As a result, travel routes changed, and work trips in particular gravitated to the periphery of the central city and further afield where office and workspace was available. Car use increased during the recovery (Koorey, 2018), while other travel

modes suffered, mostly due to the dispersed nature of new work and school trips, but also because having a car nearby was seen as prudent risk management by some.

Policy context

Christchurch had ambitions, at least in some quarters, for a more liveable, sustainable and healthy city before the earthquakes (Clark and Curl, 2019; Koorey, 2018; Stevenson and Brindson, 2017). Shortly after the earthquakes, the Christchurch Transport Strategic Plan 2012-2042 (Christchurch City Council, 2012) ambitiously proposed four goals around a vision of Keep Christchurch Moving Forward by providing transport choices to connect people and places. The goals were to: improve access and choice; create safe, healthy, and liveable communities; support economic vitality; and create opportunities for environmental enhancements. 'Building back better' following the earthquakes was a clear theme in the plan. An extensive 'Share an idea' public engagement initiative was carried out within three months of the earthquake (Nicholson and Wykes, 2012) and focused on four areas: move (transportation), market (business), space (public place and recreation) and life (mixed uses). Huge public participation generated 106,000 ideas which informed the development of the Draft City Centre Plan (Nicholson and Wykes, 2012). Feedback around transport yielded themes that were not inconsistent with ideas that had been presented prior to the earthquake (Koorey, 2018).

Immediate actions

Following the earthquakes, large scale demolition and early reconstruction meant the city centre was cordoned off as inaccessible to the general public and approximately 8000 dwellings were 'red-zoned' as areas not to be rebuilt (Brand and Nicholson, 2016). In vacant lots of land following demolition a range of pop-up ventures emerged with the goals of activating and filling social functions that had been lost. A grassroots transitional movement emerged which included, among others:

> *Viva: a community group committed to actively promoting sustainable developments for the Christchurch rebuild;*
>
> *Gapfiller: an urban regeneration initiative that temporarily activates vacant sites;*
>
> *Greening the Rubble: volunteers who design, construct and maintain parks and gardens on the sites of demolished commercial buildings.*

(Brand and Nicholson, 2016)

Building on these grassroots initiatives, the Transitional City programme was indicated in city planning and addressed system factors such as relaxing existing planning regulations, establishing contestable funds for community transitional projects and brokering access to private land (Brand and Nicholson, 2016). In practice, larger scale and more permanent masterplans and projects have been progressed by government and landowners. However, early opportunistic low-cost projects helped set an agenda for the city. The importance of community-led, including Māori-led, responses is widely acknowledged in writing about the Christchurch story (Cretney, 2019; Kenney and Phibbs, 2015; Vallance and Carlton, 2015).
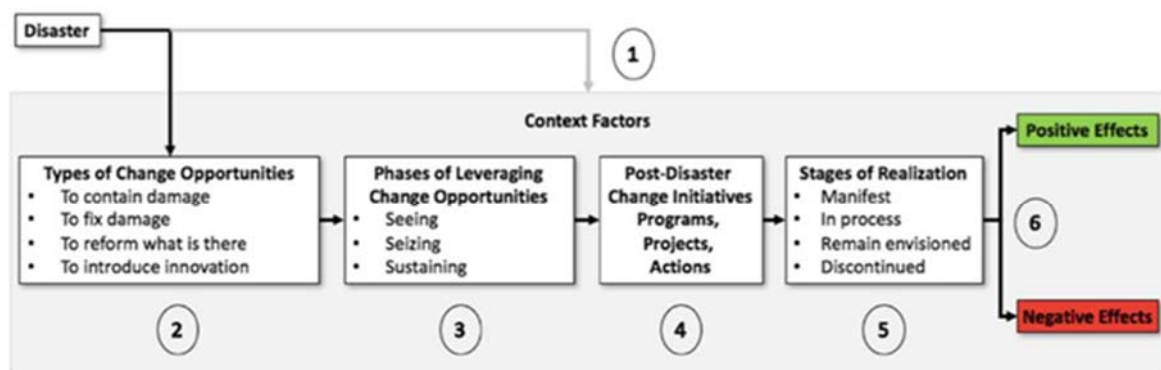
Some short-term initiatives were counter-productive within the context of the longer-term vision (Koorey, 2018). For example: a makeshift bus service led to low bus patronage, cycle lanes were removed to make way for extra vehicle lanes and roads were repaired 'like for like' even if they didn't function for all road users very well. Strong national leadership was necessary as the magnitude of the response needed was beyond the capacity of local government alone. However, there was difficulty balancing fast and authoritative decision-making, which can speed up a disaster response, with more bottom-up engagement processes in the response and recovery period, especially in the months and early years following the earthquake (Brundiers, 2018). Hence the resulting programme of action often did not completely align with the desired intention for the city by local residents and officials and the focus was on

putting the city back to how it was, fixing infrastructure without improving it (Brundiers, 2018). Structural arrangements such as the requirements of insurance companies also underpinned this focus on putting things back as they were (Brundiers, 2018). Overall, this missed opportunities to lever off well-thought out plans that were developed before and immediately after the earthquakes.

Longer-term developments

Since the earthquakes, progress towards the envisioned sustainability has been mixed, with some opportunities lost but also some significant improvements being implemented (Brundiers, 2018). For example, as part of the vision to create a cycling city, $156m is being invested in 13 cycleways across the city, building on existing plans[1]. In addition, the establishment of a unique Māori design agency[2], as both the mana whenua voice and design expertise for the Christchurch rebuild, means that Ngai Tahu has led projects that have helped to re-indigenise the central city as part of core anchor projects. Developments include sustainable and user-friendly spaces, supported by a new 30 km/h speed limit in the city centre to improve safety. However, some contentious street designs from before the earthquake remain (eg the multilane one-way system around the Christchurch city centre which provides well for motorised traffic but not for active modes, which runs counter to the more people focused city planned for Christchurch).

Figure 3.2 Framework leveraging disasters as opportunities (Brundiers, 2018)

A useful model for considering disasters as opportunities for sustainability, by Brundiers (2018), allows a range of post-event dimensions to be conceptualised (figure 3.2).

Using this framework, some key points related to the Christchurch recovery were noted (Brundiers, 2018):

- Cross scale networks of agents have benefited the progression of the city's goals, but this has been complicated by a central government-led disaster response focusing on fixing Christchurch to pre-earthquake standards.

- The reality of a disaster of the magnitude of the Christchurch earthquakes is that both top-down and bottom-up driven projects are needed.

- Build back better has been realised through both small and transformational changes for a more people oriented/sustainable city.

- Being ready to see opportunities through trained people, but also through existing policy that sets a vision for a city. Seizing opportunities requires agents of change, and capacity is important.

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[1] https://www.nzta.govt.nz/walking-cycling-and-public-transport/cycling/investing-in-cycling/urban-cycleways-programme/christchurch-urban-cycleways-programme/christchurch-city-urban-cycleways-projects/

[2] https://matapopore.co.nz/

Sustaining change means long-term commitment, hanging in there and reinforcing collaboration are essential for longer-term impact.

What does this mean for New Zealand and leveraging COVID-19 to advance transport goals?

- **A key lesson from Christchurch is to prepare for disasters before they hit by envisioning desired sustainable transport outcomes during normal times**. As pointed out by Koorey (2018), it is not necessary to have a disaster before asking residents what kind of community they would like. It does appear that the foundation of a desire for a more sustainable city, building on already strong attributes (eg the strongest cycling city in New Zealand), can be useful when disruptions happen.

- Conversations about progressing sustainable transport changes are not new and, if handled professionally, conversations and action can then be seen as a reasonable use of an unfortunate event, as opposed to an opportunistic grab at pushing through niche ideas in a disingenuous way. Christchurch highlighted how important it is to combine a strong central government disaster response with local aspirations to achieve a better city.

- Within the current COVID-19 context existing government policy and initiatives, coupled with the new mobility experiences during the disruption (such as cycling on calm streets) and effective community/stakeholder engagement, are likely to be important cornerstones for progressing transport change conversations and action.

3.3.2 Hurricane Katrina and Hurricane Rita

Background

In August 2005 Hurricane Katrina, a category 5 tropical cyclone, devastated south-eastern Louisiana and New Orleans, damaging levees and flooding nearly 80% of the city (Fields, 2009). At least 1500 people were killed, and hundreds of thousands were displaced or left homeless (Kates et al., 2006; Litman, 2006). Almost four weeks later, Hurricane Rita made landfall in southwestern Louisiana, further damaging infrastructure in New Orleans (Amdal and Swigart, 2010; Litman, 2006). Most deaths from Hurricane Rita were due to factors associated with the evacuation process (gridlock, heat, and fuel shortage) before the storm had arrived (Litman, 2006). Five months after the hurricanes, the census showed a population decrease of 64%, with implications for the city's economy, housing, transport and ability to rebuild (Kates et al., 2006).

A city's trajectory

New Orleans is primarily positioned on low-lying, coastal swampy wetlands, and the city is protected from flooding by drainage and a series of levees. From the 1940s to 1960s rapid population growth led to the expansion of the city's footprint into the most hazardous and flood-prone areas (Fields, 2009). Since that time, environmental changes and coastal erosion has led to these low-lying suburbs in particular becoming more susceptible to flooding (Fields, 2009).

It has been suggested that the trajectory for full recovery (infrastructure, population, economy) of a city or country after a disaster is strongly tied to pre-disaster trends (Kates et al., 2006). In the case of New Orleans, the city had been undergoing a 45-year decline in population and economic depression prior to the hurricanes. Evacuation, the destruction of tens of thousands of houses, a 40% spike in rent (Gonzales, 2008) and many people being ineligible for state insurance (Fields, 2009) following the hurricanes meant that many people never returned to the city (Kates et al., 2006). By 2012, 86% of the population had returned (Ride New Orleans, 2014) but that figure has since plateaued.

Changes in the public's behaviour

For those who remained in the city after the hurricanes, there was a shift in recreational behaviour and use of public space. A series of interviews conducted with residents in public parks found that people whose houses had been flooded were more likely to visit the park to escape than those whose houses had not been flooded. It has been theorised that parks may act as a coping resource for communities by providing people with social, physical activity, and escapism opportunities (Rung et al., 2011).

In the case of the 2012 Hurricane Sandy which affected 24 states in the USA, it was reported afterwards that people who were wealthier were more likely to keep working from home for longer after the disaster than people who had a lower income (Kontou et al., 2017).

Evacuation and organisational change to processes

The majority of the Katrina-based academic literature about the transport system is focused on lessons learned from the two evacuations. Whilst briefly described here, the aim of this case study is to describe the long-term disruptive effect of the hurricanes on New Orleans' transport system.

The evacuation from Hurricane Katrina, while successful for approximately three-quarters of the population who had access to a private vehicle, failed for those who depended on public transport, mostly low socioeconomic, Black, and low-lying communities. Although city authorities had knowledge of the number of people who did not have the means to evacuate, no plans were made to provide alternative transport (Litman, 2006). In the case of Hurricane Rita, the population evacuated on an extremely hot day and, again, there was an over-reliance on automobiles. The sudden exodus of thousands of vehicles on a hot day led to gridlock, fuel shortages and at least 95 deaths from dehydration and hyperthermia (Litman, 2006).

Litman (2006 p.23) suggests that a test to understand a transportation system's overall fairness and effectiveness is 'its ability to accommodate the needs of the most vulnerable users under extreme conditions'. The performance of the two New Orleans evacuations demonstrates underlying systemic disparities in its transportation system. Following the hurricanes, changes were made to the city's systems for disaster management, emergency response and readiness to act (Kontou et al., 2017; Litman, 2006). For the transport system, this included improved evacuation plans incorporating a staged timeline for action starting 72 hours before a storm hits (Regional Transit Authority, 2020a).

The aftermath – policy and rebuilding decisions

Rebuilding policies in the immediate wake of the hurricanes, and for up to four years after, have been described as 'laissez-faire' (Brand and Seidman, 2012). This was partly due to the weakened position of the municipal government who had to rely on philanthropic funding and federal government grants (Brand and Seidman, 2012), as well as the failure of numerous groups and planning processes to gain traction (Brand and Seidman, 2012; Fields, 2009). While the Unified New Orleans Plan (UNOP), a $14.5 billion dollar budget plan allocated over a ten-year timeline, was developed in August 2006, it wasn't until June 2007 that some aspects of the plan were implemented, and not until 2010 that the city budget was designed to achieve the goals of the plan (Brand and Seidman, 2012).

In the initial period after the hurricanes, no clear vision for the city's rebuild meant that no clear policy decisions, especially for long-term change, were made (Snyder, 2018). In these circumstances, feelings of public distrust, vulnerability and rivalry were intensified by the city council questioning the ongoing viability of flood-impacted neighbourhoods, leading to under-resourced community groups and neighbourhoods becoming strong voices in decision-making processes (Brand and Seidman, 2012; Fields, 2009; Hirsch and Levert, 2009).

Long-lasting effect on public transport

Flooding from the hurricanes damaged nearly all of the Regional Transit Authority's (RTA) vehicles and facilities to some extent, and nearly half of the city's buses were lost (Brand and Seidman, 2012). Ironically, these could have been used to evacuate the population in need, thereby also saving the buses. For one year after the hurricane public transport was fully subsidised by the Federal Emergency Management Agency (Snyder, 2018).

In many ways, the widespread damage to the network provided an opportunity for the improvement of aspects of the public transport system. However, in the first few years after the hurricane RTA's policy was to seek all possible funding from government grants, meaning that build-back was dependent on and guided by which grants were won rather than following a clear vision (Snyder, 2018). Some changes included the construction of an additional streetcar line funded by a $45 million grant from the Department of Transportation. In addition, the bus fleet was replaced with accessible vehicles that ran on bio-diesel, and some bus corridors were extended (Regional Transit Authority, 2020b)

These ad hoc rebuilding projects have resulted in an equity imbalance evident 15 years after the hurricanes. The decision to expand the streetcar project, while popular for encouraging the return of tourists, disadvantaged some residents due to its poor integration with the bus system resulting in more transfers and leaving people struggling to access work (Snyder, 2018). In addition, it lacks a dedicated lane and does not have priority at traffic lights, meaning it travels no faster than general traffic or buses (Ride New Orleans, 2014).

In 2006, 17% of the pre-Katrina public transport had been restored (Liu et al., 2006). This figure reached 36% in 2012 and 65% by 2015, despite 86% of the population having returned to the city (Ride New Orleans, 2015, 2014). By 2018, only five of the original 19 high-frequency bus routes were in operation (Snyder, 2018). In 2019, while only 12% of public transport-reliant residents could reach the region's jobs in 30 minutes or less, those with a vehicle were able to reach 89% of the region's jobs in the same time period (Ride New Orleans, 2019). The RTA has since worked with community advocacy group Ride New Orleans to develop a strategic plan for 2018-19 which prioritises better services to low-income communities (Regional Transit Authority, 2017).

A walking and cycling success story

The Lafitte Greenway is a 2.6-mile walking and cycling shared path that follows an abandoned rail corridor between four historical districts. Prior to the hurricane, plans to transform this unused corridor into a green space had become dormant (Fields, 2009). After the hurricanes, public energy to revive this space was renewed and this was supported by the City Council. However, there was also strong public opposition by those who considered that the greenway would jeopardise a housing project (Fields, 2009). After considerable negotiation between public departments, the greenway was approved and opened in 2015. It incorporates stormwater management, native plantings and a revitalisation plan for zoning and economic development. Currently there are plans to further extend it by 0.5 miles for better connectivity to other parts of the city (Friends of Lafitte Greenway, 2020).

What does this mean for New Zealand and leveraging COVID-19 to advance transport goals?

- Act quickly and work to a vision: A lesson from New Orleans was that the municipal government's failure to efficiently establish and implement a vision for recovery meant that build-back projects were disjointed and haphazard (Brand and Seidman, 2012; Fields, 2009; Snyder, 2018).

- Strong and consistent communication with the public: While there was strong public engagement after the hurricanes, this was built on an underlying distrust of the authorities based on a long history of conflict, discrimination and systemic underfunding of services to low-income populations

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(Brand and Seidman, 2012; Fields, 2009). For New Zealand, this is a reminder of the importance of both strong and consistent messaging to the public about any proposed or actual changes, and wider issues of governance, inclusivity and equity.

- Build resilience against future disruptions: New Orleans' systems were not designed with sufficient 'diversity, redundancy, efficiency, autonomy, and strength in its critical components' to efficiently recover after the hurricanes (Litman, 2006). For New Zealand, developing a transport system that incorporates all of these components will allow for greater resilience in the network. This may include:

  o creating networks with multiple links to each destination

  o designing critical elements of the roading network to be fail-safe

  o developing a transport system that is multi-modal and can provide a variety of mobility options

  o working with communities, vulnerable groups, and associated organisations to identify what their needs are, and

  o ensuring that transport planning considers people who do not speak English, people with low incomes, Māori, and people with disabilities.

- Provide free or subsidised public transport: For one year after the hurricanes, the city provided free public transport as residents and business economically recovered (Snyder, 2018). This could be a useful lesson for New Zealand in the context of COVID-19 as it may encourage users back to public transport, promote equity of access in times of economic hardship and mitigate barriers to using this mode, such as fear of contagion.

3.3.3   Olympics – Sydney 2000 and London 2012

Mega-events such as the Sydney 2000 and London 2012 Olympics are examples of planned disruptions. Prior to these events, significant planning and implementation of strategies to cope with the expected increase in transport demand occurred (often with support from Olympic Committee representatives). These strategies included land-use integration with transport services and physical infrastructure to increase network capacity, such as upgrades to roads and public transport stations and new walking and cycling routes (Mulley and Moutou, 2014; Parkes et al., 2016). Physical changes were coupled with large-scale behaviour change approaches, such as mass marketing campaigns, free travel cards, journey planner tools, and engagement with businesses (Mulley and Moutou, 2014; Parkes et al., 2016; Transport for London, 2013).

Both events were seen as highly successful in terms of managing transport demand, with significant changes to travel behaviour evident during the event period (Hensher and Brewer, 2002; Parkes et al., 2016). Based on a longitudinal survey of a sample of Londoners, approximately three-quarters of the sample changed their behaviour in some way during the Games (63% reduced, 28% re-timed, 21% re-routed, 19% re-moded) (Transport for London, 2013). Likewise, in Sydney public transport patronage exceeded forecasting and Sydney residents reduced the amount they travelled overall (Hensher and Brewer, 2002).

However, there is very limited evidence that these mega-events had a lasting impact on the travel behaviour of individuals. Overall, the short-term coping strategies to deal with the immediate disruption of the Games did not translate to long-term behaviour change because there was no longer an incentive or need to do so (Hensher and Brewer, 2002; Transport for London, 2013).

Several lessons can be drawn from these events:

- Transport for London (2013) reports that, of those who made at least one change to their travel behaviour during the London Olympics, 15% sustained at least one change two months after the Games (4% reduced, 4% re-timed, 3% re-routed, 3% re-moded). However, while some of this effect was thought to be because the disruption of the games revealed a better travel option, natural variation in people's behaviour and circumstances over this period was seen as having a greater effect (eg moving house, changing job). It is also difficult to assess the quality of this survey's methodology.

- The experience of the Games may mean some Londoners were more equipped to deal with future disruption, there were small increases in Londoners reporting it was 'easier' to change their travel behaviour if they needed to (Transport for London, 2013).

- The London Olympics illustrated the important role of businesses and employers in bringing about transport behaviour change in the context of disruption, particularly when coupled with effective engagement and messages that resonate with their needs and goals (Jones and Woolley, 2019). After the London Games, some working from home behaviours were maintained; 20% of commuters in the sample reported working from home once a week two months after the Games compared to 13% before the Games. Transport for London (2013) also notes one large company maintained the walking and cycling encouragement initiatives that were developed during the Games (eg casual work clothes to encourage walking and cycling, walking and cycling outings with staff at lunchtimes and reduced business travel).

- As Parkes et al. (2016) describes, the short-term response to the disruption may not be enough to lead people along the path to behaviour change where behaviours are supported by underlying motivations, especially when the surrounding context returns to business as usual. However, while substantial changes were not evident across the London population, Transport for London (2013) argues that, where there was a desire or trend towards a certain behaviour prior to the Games (ie cycling or working from home), the travel demand activities during the Games may have acted as an additional trigger for longer term change. From a behaviour change theory perspective, this suggests that fostering behaviour change following or through a disruption may need to be targeted at individuals or organisations who are contemplating or already showing some desire to change, not simply those that were forced to make a short-term adaptation.

Long term transport legacies of the Olympics?

For London 2012, there was deliberate ambition and a strategy for how the Olympics were to leave a transport legacy (Greater London Authority, 2012). This document clearly outlines how the measures put in place to improve transport during the Games would also benefit larger socio-economic and environmental goals. There were intentions to use the Olympics to transform and improve the quality of life in the six host boroughs.

Zhou et al (2018) analysed spatio-temporal regional level data between 2010 and 2015 to examine the extent of urban regeneration in London's eastern boroughs after the Olympics. Significant improvements in indicators such as income, employment, education and health were seen. However, access to housing became worse, suggesting a degree of displacement of poorer residents and gentrification rather than regeneration (Zhou et al., 2018).

The national government produced documents one year after the Games which describe the transport legacy left by the Olympics, including increased rail and Tube services and capacity, new walking and cycling routes and a bike hire scheme (Department of Culture Media and Sport, 2013; UK Government,

2013). These documents present the disruption of the Olympics as a catalyst, serving to bring forward urban improvements enabling increased funding. However, in general there is a lack of readily available, long-term, independent research which analyses the transport legacy of the Games. A health impact assessment completed prior to the Games predicted the redevelopment would provide green areas for cycling and walking and better public transport, but this would be coupled with increased road traffic, noise and air pollution (Mccarthy et al., 2010).

In Sydney, the lack of a lasting impact on travel behaviour or policy was partly attributed to a failure to bring the public along or provide a sound rationale for continuing the multi-modal mandate so that people understood the need for change (Mulley and Moutou, 2014). Prior to and during the Sydney Olympics, institutional changes improved collaboration and decision-making. For example, a specific agency was established to manage transport and facilitate multi-modality, with the resources and authority to solve problems as they rise. However, case study research reports decision-makers failed to act quickly enough to embed these changes after the Olympics, meaning that organisational knowledge was lost. For example, seconded staff returned to their usual positions and constant change in ministerial positions meant a lack of continuity for leveraging long-term change (Mulley and Moutou, 2014)

It is also important to mention that, in the case of the Rio de Janeiro Olympics in 2016, despite extensive planning and promises to leverage the Games as an opportunity to improve transport access for low-income groups, analysis of longitudinal data suggests the expansion of the public transport network in fact left a legacy of poorer accessibility for these groups (Pereira et al., 2019).

What does this mean for New Zealand and leveraging COVID-19 to advance transport goals?

- Identify and capture organisational learning and capability developed through the disruption so it is not lost and evaluate policy implementation.

- Develop a strategy for how the COVID-19 disruption can advance transport goals in synergy with other socio-economic, cultural and environmental goals, with the needs of vulnerable groups at the centre of this plan.

- As part of an overall approach, target initiatives to individuals or organisations who showed some readiness or propensity for change prior to COVID-19 where the disruption may have acted as a trigger, rather than those who had to make a short-term change.

- Businesses and workplaces could have a large role to play in leveraging transport behaviour change during and following COVID-19, especially if a legitimate and ongoing driver for new behaviours can be developed which fits with their organisational goals (eg economic recovery, future resilience to deal with transport impacts on business and goals to reduce carbon footprint). Promoting ongoing work from home practices and reduced business travel are examples. Incentivising businesses to support walking and cycling (for commuting and business trips) are also options. As with the existing Public Sector E-bike Purchase Support Scheme, having the public sector lead by example could provide a suitable way forward.

3.3.4 Fear – transport and terrorism

Fear of and concerns about the use of public transport after terrorist attacks on public transport have similarities to the COVID-19 situation.

On 7 July 2005, terrorist bombs on London's transit system killed approximately 50 people and injured hundreds. Likewise, in 2004 approximately 200 people died on four trains bombed by terrorists in Madrid. Other terrorist attacks have occurred in Tokyo, Israel, Paris, and Mumbai among other cities (Hirsch et al., 2016; Litman, 2005).

In Madrid, ridership levels on trains dropped by 4% in the month of the attack and 6% in the month following, before returning to pre-attack ridership trends (López-Rousseau, 2005). In London, weekly tube ridership showed a 12.8% drop in the week immediately following the attack, with a 32% decrease at weekends, which took approximately two months to bounce back (Fasolo et al., 2008).

Madrid residents reduced train travel and overall travel but increases in car use were not seen (López-Rousseau, 2005). Londoners showed small increases in cycling and two-wheeled motorcycling, suggesting mode substitution was occurring (Fasolo et al., 2008). London's congestion charge is thought to be the reason why Londoners did not substitute the Tube with driving, highlighting how the availability of other options can affect substitution behaviours (Fasolo et al., 2008). These studies have acknowledged the potential harm of increased car travel following attacks on public transport, often citing the 9/11 example where concerns about air travel increased long-distance driving and significantly impacted the road toll (Gigerenzer, 2006).

Socio-cultural factors may affect how different communities and populations react to terrorist attacks. For example, perceptions of fear may vary depending on the frequency of the attacks and whether people become desensitised (Litman, 2005). Litman (2005, p42) also notes that:

> *When terrorist attacks occur, responsible leaders rightfully recommend that people return to their normal habits, including public transit travel. Cities repair their public transit systems and people use them, both for practical reasons and to show they are not intimidated by terrorism.*

In fact, the day after the attack in Madrid there were four times the number of train passengers compared to an average day as people attended the anti-terrorism demonstrations across the country (Litman, 2005).

In India, in-depth qualitative interviews with train passengers showed how travellers have a window of fear after attacks that influences their perceptions of and willingness to travel, which may influence people long after the attack (Hirsch et al., 2016). This qualitative study also highlighted how those with higher incomes had more choice and capacity to change their behaviour, whereas those on lower incomes reported that they had no other option but to take the train despite lingering fear concerns (Hirsch et al., 2016).

What does this mean for New Zealand and leveraging COVID-19 to advance transport goals?

- Careful and credible public communication around the use of public transport is needed during the COVID-19 disruption period and post-disruption. Fostering public trust that the threat of COVID-19 spread is either gone or being continually managed may mitigate the impact of falling ridership numbers and substitution to private cars. Similarly, it may be important to emphasise that while adaptations to the use of public transport may be needed in the short term, this mode is still central to the future of our transport system.

- To plan an effective transport policy response, it is essential to understand how New Zealanders' perceptions of fear are changing over time.

- Moving forward, having a range of transport options available to all socio-economic groups is part of mitigating the impact of future disruptions.

3.3.5 Other disruptions

In this section we briefly outline learning from two other disruptions. In these examples there was either not enough literature to inform a full case study or only certain aspects were relevant to the research questions. These examples describe how leveraging opportunities to improve transport systems have

been integrated into a broader approach to improve economic and social conditions after a crisis, which has relevance to COVID-19.

Economic crisis and sustainable transport policy in Ireland

Rau et al's (2016) analysis of Ireland's transport policy over time revealed how the Global Financial Crisis, beginning in 2008, contributed to the development of sustainable transport policy. During the 'Celtic Tiger' period (1995-2007), Ireland's focus was on 'big spend' and largely car-centric infrastructure projects to accommodate future economic and population growth. However, the economic crisis disrupted this approach, and the government's reaction was a shift to 'smarter transport' options, such as investments in cycling infrastructure, road-based public transport, and promoting walking and cycling. The *Smarter Transport: A sustainable transport future* policy was launched in 2009. While the reasons for this shift are reported to be multi-faceted, including the beginnings of an agenda challenging car-dependency, this shift was clearly tied to government reactions to the economic situation (Rau et al., 2016).

In addition, this was the first time that transport policy had been developed with a focus on public consultation and input from a wide variety of groups. This contrasted with Ireland's previous top-down approach, so much so it was referred to as the 'people's policy' by the Department of Transport. Similarly, Rau et al (2016) notes this shift took place within the existing institutional framework, so no organisational transition was required to implement decisions that were very different from the previous big spend decade.

Despite this new direction, there were also actions taken during the recession period to create jobs and stimulate the economy that were described as contrary to these sustainable transport goals (Rau et al., 2016). For example, stimulus packages for 'job-rich' and 'shovel-ready' road construction were funded. Likewise, this 'low-cost' approach initially focused on individual behavioural programmes to encourage sustainable transport, car-sharing, and teleworking (work from home), rather than a comprehensive approach to behaviour change (Rau et al., 2016).

In summary, the economic recession was a window that supported the development of a sustainable transport agenda alongside other factors, with the *Smarter Transport* policy still in place in Ireland today (Department of Transport Tourism and Sport, 2020). While Ireland may still be navigating tensions between embedding this policy and the traditional car-dependent agenda, as Rau et al (2016) points out, there is reason to be optimistic, with recent investments in bike share schemes, road-based public transport, and greenways.

Social and economic crisis in Cuba

The collapse of the Soviet Union in 1990 severed its social and economic ties with Cuba. Disrupted oil supplies and shortages in food, machinery and electricity brought Cuban life to a standstill and threw people into poverty. Fuel shortages increased public transport costs and reduced its reliability, but also greatly increased demand as many people were unable to drive private cars (Piercy et al., 2010).

Cuba implemented a range of policies to respond to these mobility, social, and economic challenges (Piercy et al., 2010; Warren and Enoch, 2010). For example, approximately two million bicycles were imported from China and 500,000 bicycles were produced locally for essential workers. Cuba also invested in public transport that minimised fuel use and maximised users (eg truck buses and camel transporters), introduced multi-share taxis, and made it compulsory for government vehicles to pick up anyone who signalled that they needed a lift. In addition, re-localisation was a key policy change in spatial planning. This policy aimed to generate social and economic activity in localised areas, thereby stimulating economic activity while reducing the need to travel. Re-localisation strategies included:

decentralisation of education and health, reversal of urbanisation, promotion of local workplaces and development of local amenities accessible by walking or cycling (Piercy et al., 2010)

Ongoing economic constraints and poor maintenance of transport infrastructure continue to suppress the travel of Cuban people overall. However, Piercy et al (2010) argue that this initial response to a crisis has, over time, embedded sustainability and resource protection into the transport system and contributed to favourable health and education outcomes comparative to the country's wealth. While Cuba's political and economic systems are very different to those in New Zealand, their restorative policy response to a severe social and economic crisis has been described as exemplary and innovative, encompassing both strong political leadership and a comprehensive approach (Piercy et al., 2010; Warren and Enoch, 2010).

What does this mean for New Zealand and leveraging the COVID-19 to advance transport goals?

- There are opportunities to advance sustainable transport in times of economic hardship. However, economic constraints should not be used as an excuse to only focus on no-cost or low-cost marketing or education initiatives.

- Finding synergies between transport policy goals and economic recovery is critical.

- Public consultation is an important factor, especially in times of economic hardship, but needs to be coupled with strong political leadership.

3.3.6 Case studies summary

These case studies provide an insight into how people and governments have experienced and responded to transport disruptions. Drawing on these insights we have developed key lessons for New Zealand, which can help inform the approach taken to advance New Zealand's transport policy goals in the context of the COVID-19 disruption and contribute to New Zealand's recovery. These lessons are outlined in Section 3.4.

3.4 Potential approaches to behaviour change following major transport disruption

Drawing on the literature, including the case studies, we outline a range of potential approaches which could contribute to advancing New Zealand's transport policy goals in the context of the COVID-19 disruption. First, to help frame these potential approaches (and others that will emerge) we briefly describe:

- types of change opportunities
- timing and capability, and
- target behaviours or outcomes.

3.4.1 Types of change opportunities

Drawing on the literature, and through the case studies, we have identified four types of change opportunities that may be triggered by a disruption (Brundiers, 2018).

- **Do nothing**: This is essentially waiting for the disruption to run its course, based on the argument that travel behaviour will return to normal once the disruption is no longer present. In most cases, do nothing is not an option

- **Mitigate**: This focuses on mitigating the impact of the disruption on the normal state, for example containing or fixing damage to ultimately restore the status quo and mitigating negative consequences of the disruption on transport behaviour (eg an increase in road traffic injuries as a result of increased driving in the post-disruption period). This also includes mitigating the effect of opposing forces during the disruption and post-disruption phases, which are attempting to facilitate behaviour in the undesired direction.

- **Reform**: Improving on what is already there. For example, amending existing policies and initiatives to benefit the desired policy direction. If actions to mitigate the effect of the disruption (eg free public transport, changes to pedestrian phasing, wider cycle lanes and shared paths) are implemented or maintained after the disruption, these could become 'reforming' opportunities.

- **Innovate or Transform**: This is leveraging the disruption to improve the situation through innovation and new ideas or a new direction.

The type of 'change opportunity' could be different for different aspects of the overall policy response to the COVID-19 disruption, tailored to geographical areas, and developed over time. For example, for public transport the initial focus may be on mitigating loss in ridership, while other more transformative changes are identified in the longer-term. For modes such as walking and cycling, reform and innovate opportunities may be appropriate in the short-term, such as temporary street installations to allow space for walking, cycling and socialising, or improving existing cycling networks.

3.4.2 Timing and Capabilities

To leverage opportunities, different capabilities are needed at different timepoints during the disruption and post-disruption periods. This includes: people who can see and identify the opportunity, those who can seize the opportunity and systems that can sustain the opportunity in the long-term (Brundiers, 2018).

This literature review, focusing on past disruptions, could be described as a seeing action, however there are likely to be many other people within national and local government, communities, and workplaces

that can also see opportunities moving forward. As such, a rapid engagement process to draw these opportunities out (eg workshops with local government) may be useful.

3.4.3   Target behaviours and outcomes

As seen in the case studies, disruptions can affect transport perceptions and behaviours in different ways (Marsden et al., 2020). The categories below are useful for thinking about what behaviour is being encouraged through the potential approaches, ie what is the end goal?

- travel mode – sustaining or encouraging particular travel modes (eg walking, cycling, public transport, shared-mobility)

- enhanced access to transport services and public space

- safer travel

- reduction in travel (eg work from home, shop online, consolidate trips)

- altering destination (eg shop local)

- altering the time of travel

- altering the route of travel.

However, it is also important that a system-view is maintained in the development of the policy response, which pays attention to the range of socio-technical influences, policy levers and actors that affect how individuals travel (Geels et al., 2017). It is important to maintain a focus on the wider system and delivery processes that will ultimately unlock the policy gains that are intended, rather than focusing on individual behaviours. Larger behavioural gains will be won over time if system levers can be influenced through disruptions.

3.4.4   Lessons from the literature to inform potential approaches

Drawing on the literature and case studies, we identified 10 key lessons or considerations which can help inform the approach taken to advance New Zealand's transport policy goals in the context of the COVID-19 disruption. These lessons are outlined in table 1 and are contextualised for relevance to New Zealand. These lessons also include insights into initiatives or directions that should be avoided. For example, actions that may take our transport system backwards (ie further imprint the regime of automobility), have negative impacts on safety, or disproportionately disadvantage specific groups.

Some examples of possible initiatives or actions are suggested in relation to each lesson, across the different policy areas of: regulatory and institutional; infrastructure, platforms and services; economic tools; spatial and place-based planning and education, engagement, and awareness (Waka Kotahi NZ Transport Agency, 2019).The appropriateness of specific actions will need to be further investigated as the COVID-19 situation unfolds.

Table 1: Key lessons from previous disruptions to inform potential approaches for New Zealand's COVID-19 transport response

Key lesson	Key lesson description	Relevant case study(s)	What does this mean for potential approaches in New Zealand in the context of the COVID-19 disruption?
Capture adaptations to and learnings from disruptions and evaluate the policy response	There is a lack of high-quality research and evaluation literature which examines policy actions following a disruptive transport event, making it difficult to learn from these events (Marsden et al., 2020). If disruptions and change are acknowledged and planned for as a part of everyday life, proactively learning from these instances can become embedded (Marsden et al., 2020). As with the Sydney Olympics, organisational learning and capability developed through a disruption can be lost (Mulley and Moutou, 2014) or, in the case of Hurricanes Katrina and Rita, contribute to improved disaster response strategies (Kontou et al., 2017; Litman, 2006).	Christchurch Earthquake Olympics – Sydney	Establishing processes and capability to proactively learn from and leverage future disruptions (eg from construction projects such as Auckland's City Rail Link to natural disasters) will be beneficial, particularly as disruptive events from climate change may become more common.
Clear vision or policy direction prior to or immediately after the disruption	A key lesson from Christchurch is to prepare for disasters before they hit by envisioning desired sustainable transport outcomes during normal times. The response to disasters is much more likely to build back better if there is a pre-existing, well-articulated vision of what better looks like, or there is a concerted effort to establish a clear vision and direction soon after the disruption (Brundiers, 2018; Koorey, 2018). In New Orleans, the municipal government's failure to efficiently establish and implement a vision for recovery meant that build-back projects were disjointed, haphazard (Brand and Seidman, 2012; Fields, 2009) and contributed to equity imbalances (Snyder, 2018). Whereas, pre-disruption policies and groundwork for a more sustainable	Hurricanes Katrina and Rita Christchurch Earthquake	In New Zealand there are a range of policy documents which capture the vison of a safer, more inclusive, sustainable transport system. As a next step, a process of rapidly and proactively engaging with people at national and local levels of government (and possibly industry and communities) may help see, seize, and sustain opportunities to advance the implementation of these transport policy goals, building on the lessons in this review. This seeing process will be important for identifying opportunities for niche innovations, and how they could be developed and supported.

Key lesson	Key lesson description	Relevant case study(s)	What does this mean for potential approaches in New Zealand in the context of the COVID-19 disruption?
	transport future in Christchurch provided a platform for responsive plans after the earthquake.		
Disproportionate impact on vulnerable groups	Several studies highlight how transport disruption can disproportionately impact low-income groups, because they often have fewer options or capacity to adapt (Hirsch et al., 2016; Marsden et al., 2020; Masud, 2019), and may be dealing with systemic disparities in the pre-disruption transport system (Litman, 2006). In addition, research suggests that the policies and initiatives implemented in the disruption response can also serve to create or reinforce inequalities (Birkmann et al., 2010; Marsden et al., 2020; Pereira et al., 2019; Zhou et al., 2018).	Hurricanes Katrina and Rita Olympics – London and Rio de Janeiro	There is a need to place vulnerable groups (eg low-income groups, the unemployed, and people living with disabilities) who are likely to be most affected by COVID-19 at the centre of the transport policy response. Engagement with these groups should be part of the response strategy. Initiatives to make public and active transport safer, financially feasible, easier and more attractive, to support inclusive access among vulnerable users should be investigated. Potential examples include public transport subsidies and E-bike subsidies.
Leadership, communication, and engagement	Strong leadership coupled with public engagement and clear communication is extremely important in the disruption and post-disruption period, including times of economic hardship (Rau et al., 2016). Careful and credible public communication may help foster public trust in the government's response (Brand and Seidman, 2012; Fields, 2009) and help mitigate reductions in public transport ridership (Litman, 2005). The Christchurch Earthquake experience also showed us how it is necessary to balance strong government leadership and decision-making with community engagement and support for more informal citizen-led innovations (Brundiers, 2018).	Irish recession Christchurch earthquake Transport terror attacks	Clear communication and role-modelling to enhance public trust that the risks of COVID-19 transmission on public transport are being managed or are no longer present could help mitigate possible reductions in public transport ridership. This could also include messaging about how important public transport is to New Zealand's future, including supporting economic recovery by mitigating congestion. A public conversation about how transport should be developed in New Zealand could help foster a public mandate for advancing New Zealanders transport goals, in conjunction with economic recovery plans. Engagement with the Waka Kotahi Māori Partnerships team to explore how Māori needs and aspirations can be placed at the centre of the response.

Key lesson	Key lesson description	Relevant case study(s)	What does this mean for potential approaches in New Zealand in the context of the COVID-19 disruption?
Mitigate the impact of opposing forces	Depending on the disruption, specific strategies may be needed to mitigate the impact of the disruption, restore transport behaviour and prevent further adverse outcomes. In New Orleans, for one year after the hurricanes the city provided free public transport as residents and business recovered economically (Snyder, 2018). Lasting shifts to increased car travel after a disruption may negatively affect the road toll (Gigerenzer, 2006).	Hurricanes Katrina and Rita Transport terror attacks Christchurch earthquakes	It is important to examine what proactive steps can be taken to restore and even enhance public transport patronage once the threat of COVID-19 transmission has been mitigated or eliminated, particularly in the context of economic recession. Full fare or partial fare subsidies have been introduced at certain stages in New Zealand cities, so extending these strategies could be a way to encourage users back to public transport, and support equity of access and safety during economic recovery.
Understanding transport-related perceptions, behaviour and broader socio-cultural conditions	In addition to the nature and scale of the disruption, socio-cultural factors may affect how people react to a disruption and therefore how governments prepare and respond. In addition to disrupted travel perceptions and behaviour (for example lingering fear of using public transport), public distrust and uncertainty can be heightened following a disaster (Hirsch and Levert, 2009; Kates et al., 2006).	Hurricanes Katrina and Rita Transport terror attacks	It is important to use data and engagement to: • gauge levels of distress and uncertainty in relation to COVID-19 to ensure initiatives in the disruption and post-disruption period are appropriate and do not generate further harm • gain an in-depth understanding of how New Zealanders have changed their transport behaviour during the COVID-19 disruption, including socio-economic and geographical differences, and their current transport-related perceptions • understand where there may be capacity for change, be it on a street, in a community, a workplace or a region, but also which groups need transport support and how this can be incorporated into the disruption and post-disruption response. This use of data and engagement will help guide where, when and how to respond.

Key lesson	Key lesson description	Relevant case study(s)	What does this mean for potential approaches in New Zealand in the context of the COVID-19 disruption?
Adapt the approach to the target group or context	Fostering behaviour change following or through a disruption may be more successful if targeted at individuals or organisations who are contemplating or already showing some desire to change, not simply those that were forced to make a short-term adaptation (Parkes et al., 2016). In addition, as demonstrated by the London Olympics case study, businesses and employers could have an important role to play in bringing about transport behaviour change in the context of disruption, particularly when coupled with effective engagement and messages that resonate with their needs and goals (Jones and Woolley, 2019).	London Olympics	As part of the overall policy response, it is worth investigating how initiatives in the disruption and post-disruption phases could be targeted to individuals or organisations who showed some readiness or propensity to change their behaviour prior to COVID-19, where the disruption may have acted as a trigger. However, this focus should be in combination with a focus on vulnerable groups who may have no capacity to change and limited transport options. Businesses and workplaces could have a large role to play in leveraging transport behaviour change during and following COVID-19, especially if a legitimate and ongoing driver for new behaviours can be developed, which fits with their organisational goals (eg economic recovery, future resilience to deal with transport impacts on business, and goals to reduce carbon footprint). Promoting ongoing work from home practices and reduced business travel are examples. Incentivising businesses to support walking and cycling (for commuting and business trips) are also options. As with the existing Public Sector E-bike Purchase Support Scheme, having the public sector lead by example could provide a suitable way forward.
Synergy between transport, disruption recovery, and broader societal goals	The experiences of Ireland and Cuba show us that there are opportunities to advance sustainable transport in times of economic hardship but finding synergy between the transport initiatives implemented and economic recovery is critical (Piercy et al., 2010; Rau et al., 2016). Attempts to align transport goals and solutions with broader socio-economic, cultural, urban regeneration and	Economic recessions in Ireland and Cuba London Olympics Christchurch Earthquake	The likelihood of turning the disruption of COVID-19 into an opportunity will increase if the transport policy response is closely linked with goals for economic recovery. This means our approaches to encourage transport behaviour change need to cut across several areas: on-going COVID-19 prevention and mitigation, economic recovery, equality, climate change, safety and health and resilience.

Key lesson	Key lesson description	Relevant case study(s)	What does this mean for potential approaches in New Zealand in the context of the COVID-19 disruption?
	environmental goals were also seen in the Christchurch Earthquake and the London Olympics (Christchurch City Council, 2012; Greater London Authority, 2012). Ireland's experience also shows that it is unhelpful to only focus on no-cost or low-cost marketing or education initiatives to bring about transport behaviour in times of economic recession (Rau et al., 2016).		For example, policies that encourage walking and cycling, such as investment in high-quality walking and cycling infrastructure, bike parking and end of trip facilities, can have multiple benefits, including improving access to employment and essential services, while enabling physical distancing. There could also be opportunities to maintain or re-introduce strategies implemented during the level 4 COVID-19 lockdown that support walking and cycling (eg Auckland's pedestrian light phasing which prioritises pedestrians). Comprehensive speed management regimes to improve safety, the quality of local environments and opportunities for walking and cycling could also support local commerce by increasing foot traffic. Likewise, opportunities to enhance public spaces in town centres could provide mobility benefits, increase space for physical distancing but also support local economies. Thinking more fundamentally and long-term, consideration of land-use and housing policies are needed so it is feasible to live, work and shop locally. This may also reduce the need to travel in the event of a disruption, but also overall.
Resilience, a multimodal transport system, and land-use	As we saw with Hurricanes Katrina and Rita, limited adaptability in a transport system can mean greater disruption in the event a disaster happens (Litman, 2006). Therefore, developing a transport system that provides a variety of mobility options can reduce the impact of a disruption, as well as align with environmental, health, inclusivity and safety goals (Wang, 2015).	Hurricanes Katrina and Rita	New Zealand's ability to deal with future disruption could be enhanced by a more multimodal transport system. It would be useful to investigate whether messages around future resilience could be a way to garner support from businesses and the public for a more multimodal New Zealand. Although increases in walking and cycling during the level 4 lockdown may not be sustained, this experience may have fostered a realisation that having more transport options

Key lesson	Key lesson description	Relevant case study(s)	What does this mean for potential approaches in New Zealand in the context of the COVID-19 disruption?
	There are numerous examples of bikes being used immediately following a disaster (eg cargo bike deliveries), in the short-medium term as an alternate transport option and in the longer-term to help with access to services (Fasolo et al., 2008; Kirkpatrick, 2018; Page, 2014; World Bicycle Relief, 2018).		available can protect us against future harms and have many other benefits. Although this will depend on the nature of the event, improving bike access, infrastructure and capabilities may help New Zealanders maintain accessibility after a future disruption.
Reducing overall travel as a policy goal?	Disruptions such as the volcanic eruption of Eyjafjallajökull in Iceland in 2010 have highlighted society's hyper mobility and suggest that a reduction in overall travel also needs to be considered in efforts to combat global challenges such as climate change (Britchnell and Buscher, 2011; Marsden et al., 2020). Further, researchers have also suggested using land use and transport planning to support localism and reduce overall mobility to deal with future disruptions, overcome environmental problems, and promote resilience (Ferreira et al., 2017).		It can be argued that the COVID-19 experience has highlighted New Zealand norms around excess mobility, where travel has been previously seen as essential but during the time of disruption there were adaptations and capacity to reduce overall travel. It is worthwhile considering how reduced travel among those who have the choice to do so could be a future transport policy goal, and if it is possible to align reduced travel with economic recovery goals. Maintaining a focus on some working from home and teleconferencing practices may be a short-term approach to introduce this concept. This could include encouraging less inter-city business travel which could have positive impacts on safety and the environment, as well as support on-going COVID-19 management. During and post-COVID-19, efforts to encourage supporting local business and services in the short-term could be supported by land-use adaptations in the longer-term. However, care needs to be taken that reduced travel does not mean social exclusion among groups who experience transport disadvantage.

4 Discussion

In this section, the overall themes that we have identified from the literature are discussed. These themes can serve as considerations for specific actions before, during and following disruptive events, including COVID-19. The limitations to the review are also outlined.

The potential for leveraging disruptions

Disruptions at various scales, from life events to large global disasters, do present a window of opportunity to influence behaviour and policy change, but timing, public engagement and several other contextual factors are important. The size, scale and longevity of the disruption have very real impact on the likelihood that systemic change will emerge from it. Generally, patterns from previous disruptions suggest that behaviours will eventually return to normal unless proactive strategies are mobilised. Waka Kotahi data from September 2020 (Waka Kotahi NZ Transport Agency, 2020) indicates that by June 2020 New Zealand traffic volumes had returned to pre-COVID-19 levels, and that for New Zealanders the extra walking and cycling around their neighbourhood during COVID-19 level 4 in March/April 2020 steadily dissipated over the same period.

Although our case studies of previous disruptions present a mixed view, the experiences of disruptions such as the Christchurch Earthquake, London Olympics and the Irish economic recession do offer valuable lessons for how disruptions can become opportunities. In the context of climate change action, and various other policy platforms which support sustainable mobility, New Zealand may be in an even better position than in these historical examples. In addition, the amount of change we might realistically expect from disruptions might be more at the conceptual level, or within organisations and institutions (Birkmann et al., 2010). For example, challenging ways of working and planning new ways of doing things and, at the very least, documenting learning and adaptations that have taken place at individual and organisational levels during the COVID-19 disruption (Marsden et al., 2020).

Seeing, seizing and sustaining?

The response to disasters is much more likely to 'build back better' if there is a pre-existing, well-articulated vision of what better looks like. Proactively seeing opportunities to counter possible opposing forces and advance transport policy actions are an important first step. The Christchurch case study showed how the combination of an existing vision for an improved Christchurch and a network of change agents in central and local government and the community were crucial for advancing sustainability goals following the earthquake (Brundiers, 2018). There are a range of agents, experts and academics, and community advocates that could have an important part to play in rapidly seeing the potential opportunities from the COVID-19 disruption. However, converting this cutting edge seeing into wider social license for change and policy implementation is a challenge. Community engagement (discussed further below) at local, city and national levels is important for progressing these opportunities beyond niche ideas.

However, disruptions are also emotionally challenging for people and care is needed to focus on the right thing at the right time. In the early phases of an event, especially where there is significant hardship or loss of life, a focus on people's immediate welfare is likely to be the only credible narrative. However, the Christchurch earthquake experience suggests that there may be a 'Goldilocks' period, ie where the immediate threat of the disruption has passed for most, but the event and positive altered behaviours are still proximal to people's memory and there is a fertile moment for re-visioning, experimenting, and actioning policy. The Christchurch 'Have your say' engagement also provided a way for people to

participate in something positive and forward looking, which may to some extent act as an antidote to the negative aspects of the disruption.

It is also crucial that in the seeing and seizing phases, transport goals are integrated with broader disruption management and recovery, social, and economic goals (Rau et al., 2016). For example, there currently appears to be momentum and encouragement for people to spend locally and support local businesses. Could this be combined with a type of 'walk local, bike local, buy local' campaign to marry up transport and economic objectives and eventually link with land-use changes? However, it would be important to ensure that the physical environment is supportive of these activities, so that the campaign has credibility and mechanism by which change can actually happen.

The literature suggests that there is a significant challenge in sustaining efforts to bring about change in the post-disruption period, with pressures to return to the status-quo as well as high demands of recovery itself (Wiek et al., 2015). It seems clear that a city or country that has clear goals for change before a disruptive event, and/or a very proactive desire to respond to the event and change, examples of which are few in this review, will be in a stronger position to enact and sustain change following the disruptive event.

A time for engagement

Case studies of past disruptive events, including the transport terror attacks, Hurricanes Katrina and Rita and the Irish recession, highlighted the value of public engagement and communication during and post-disruptive events. Further, the Christchurch earthquake response showed that, in considering options for advancing transport policy, a post-disruption environment can be a good time for conversation about how transport should be developed in New Zealand. New Zealand already has a strong policy platform for safe, sustainable mobility and various pre-COVID-19 actions aimed to encourage public and active transport. However, a common issue with transport policy is having the public mandate to support the policy, especially if it deviates from a long-held status quo. Therefore, the different mobility experiences during COVID-19 may provide a good basis for a well-timed, user-friendly national conversation about our transport goals, cementing a public mandate for existing transport policy. Certainly, in New Zealand large-scale well-designed engagement activities at opportune times (eg Have your say – Christchurch and The Auckland Plan engagement) have been valuable exercises, even if following implementation has been patchy in both cases. If a goal is to further develop a public mandate for some of the safety, sustainability and accessibility goals that are sought through current policy, then now is a good time to initiate this conversation.

Disruptions as experiments

Disruptions are essentially planned or unplanned experiments, and we know that niche innovations, experiments or demonstration projects, are important for challenging status quo regimes (Geels et al., 2017). Being able to test new ideas in a timely and cost-effective way reduces investment risk by avoiding locking in large transport investments that may or may not advance transport goals. Building on the natural experiment of the COVID-19 disruption, planned transition experiments such as the Innovating Streets for People programme are ideal for testing new transport ideas, nudging people to change their behaviour and contributing to a wider groundswell of support for sustainable modes. Other programmes may also be pertinent and could be leveraged at this time.

Innovating Streets for People is an example of a government programme that existed before COVID-19, which means there is a high degree of legitimacy in developing and extending this tactical urbanism focus to further respond to COVID-19. Using data and engagement information could identify potential sites (be

it a street, a community, a workplace or city) for further experiments, where initial COVID-19 activities may have fostered an appetite for change.

It is important that experiments lead to change and, following the logic of the previous disruptions outlined in this review, tactical projects to test safer or more user-friendly streets will lose any relevance if they are simply removed following the COVID-19 disruption. This relates to the 'don't go backwards' theme mentioned earlier. Going backwards might mean a worsening of safety or public transport ridership, but also the removal of innovative trials even if they were successful.

People are more adaptive than we think

Transport planning is often framed as difficult and slow to change (Marsden et al., 2020). However, a range of disruptive events have shown (eg London tube strikes, terrorist attacks and Olympic Games) that people and organisations can and do adapt when they are required to, and that many people are multi-modal to some degree. While these short-term adaptations may not reflect lasting changes to motivations and behaviours, it does suggest we could be more ambitious with advancing policy goals for transport if care is taken to carry out high quality, meaningful engagement and project delivery. It also means that studying where and why change occurred can be used to inform future travel behaviour change initiatives.

But what to do?

Taking a system view and considering the lessons from the literature review within the context of COVID-19, there are a range of potential approaches which could advance transport policy goals and ultimately influence travel behaviour, as outlined in the earlier section. Some specific initiatives, such as wider footpaths, user-friendly and sufficient pedestrian crossings and temporary bike lanes have already been used to deal with the COVID-19 disruption, and therefore maintaining or re-introducing these tools in strategic areas is a sensible step, so long as effort is made to continue engagement, trials and scaling up following.

As we have seen with past disruptions, integrating the leveraging response with broader societal and recovery goals is likely to enhance effectiveness. This means our approaches to encourage transport behaviour change need to cut across several areas: economic recovery, equality, climate change, safety and health and economic goals. For example, policies that encourage walking and cycling have cross-benefits, ie access to work/education, decarbonisation, public health, road safety and wellbeing, and can also improve a city's transport resilience and ability to recover from future shocks/disruptive events. Thinking more fundamentally and long-term, consideration of land-use and housing policies are needed so that the urban form is resilient to transport shocks (eg so people can live locally and work locally, with reduced need to travel in the event of a disruption).

Don't go backwards

While the focus of this review is on how disruptive events can be leveraged to advance policy goals, taking backward steps in the undesired direction is also a possibility. Increases in car use were seen post-earthquake in Christchurch and large-scale roading projects were built to create jobs in Ireland (Koorey, 2018; Rau et al., 2016). Careful timing and planning are needed to navigate these tensions and opposing forces during times of distress and hardship. Approaches to make sustainable transport modes easier and attractive (eg full fare subsidies post-Hurricane Katrina), may be more effective than discouraging car use initially, and a supporting focus on those who have no ability to change their travel mode is needed. Whatever the strategy, considering how negative effects on transport behaviour and adverse impacts on safety will be mitigated should be considered alongside more ambitious plans to advance policy goals. Deliberately tracking transport behaviours (eg as is happening via the Waka Kotahi

tracking research) and comparing behaviour with desired transport goals provides a useful method for gauging the extent to which travel behaviour is moving in a negative or positive direction.

Resilience includes sustainability

As demonstrated by the tragedy of the Hurricane Katrina evacuation (Litman, 2006), there is a clear relationship between transport resilience and sustainable transport. For example, promoting active travel and 'living locally' benefits climate change, road trauma and health goals, but also more flexibility in our transport system means we can better deal with shocks or disruptions. Traditional definitions of resilience focus on restoring the business as usual state. However, this link between resilience and multimodal transport system is also clear in the literature (Wang, 2015). This view could be emphasised in conversations and policy that seek more sustainable travel behaviours, particularly at times when the concept of resilience is front of mind for many individuals and business.

Top-down or Bottom up?

During and after a disruption it is also important to consider how policies, projects and actions are implemented. During crises, governments may need to employ more authoritarian measures (Imperiale and Vanclay, 2016; Nakanishi and Black, 2016), which may allow things to happen fast but is not without problems. To effectively see and seize the disruption as an opportunity, a more comprehensive network of actors is needed. Strong and supportive government leadership is clearly important for effective disaster responses, but also for ensuring sustainable policies and procedures are implemented. However, bottom-up influences and citizen-led initiatives are key in immediate post-disruption response, as well as in the Goldilocks period where creativity, and engagement, needs to progress to experimentation and sustained action.

Leave no-one behind

Disasters and travel disruptions can disproportionately impact low-income and vulnerable groups. This was particularly evident for the Hurricane Katrina case study, where wholesale failure in public transport mean poorer communities were left without evacuation options (Litman, 2006). This serves as a pertinent reminder that COVID-19 (and associated economic challenges) may be exacerbating transport disadvantage in New Zealand. Building on the idea of 'first don't go backwards', it is essential to place inclusive and equal access to opportunities at the centre of the COVID-19 transport response. Approaches, such as fare subsidies for public transport, active transport initiatives that support job access and working alongside employers for more flexible work/travel have potential, and some (eg fare subsidies) have already been used (eg immediate response to the COVID-19 threat).

Any policy response should include Māori engagement, including Waka Kotahi's Māori partnerships team. Given the place that Te Tiriti o Waitangi has in New Zealand's fabric it would be useful to learn from the current COVID-19 event and build deliberate Māori focused responses into subsequent transport policy and programmes.

What have we learned?

At the very least, systematic and robust documentation of the COVID-19 disruption will be very useful for future learning. This process should document the immediate effects on travel behaviour and associated mechanisms, as well as the behaviour change policies, programmes and actions that have been implemented before, during and following the disruption. Failures are also important learning exercises, so documenting these and highlighting the future opportunity is also important.

There may have been many other examples of how permanent change was levered from disruptive events around the world, but the literature in this area is relatively limited. This is understandable given

the immediate challenges a city or country faces during these events, but as a need for change in travel behaviour becomes more urgent the role of disruptive events in triggering step-changes in transport systems and people's behaviour will become increasingly important.

In addition, if disruptions and change are acknowledged as a part of everyday life, proactively learning from smaller scale disruptions (eg closed roads, weather events, construction projects) can become embedded, increasing understanding of how people and the system adapts.

4.1.1   Limitations of this review

Firstly, the short timeframe is a limitation of this review. We have made every attempt to capture, consider and interpret relevant data, with the aim of providing a clear direction for the government as quickly as possible, and there are clear messages from this review. However, there may be areas which could have benefited from deeper investigation if time allowed. A second limitation is the lack of peer-reviewed or grey literature describing and critically analysing the policy actions and subsequent long-term impacts of transport disruptions. So we are unsure if the leverage of transport disruptions by governments is a rare occurrence or something that is simply not documented and disseminated. There is considerable literature describing how people have responded to transport disruption, particularly in the short-term, and while this is useful it only offers part of the story. We have minimised the impact of this limitation by delving deeper in case studies where there is a sufficient level of data (eg Christchurch Earthquake), and identifying common factors, across multiple disruptions, that may enhance the effectiveness of a post-disruption policy response.

The scope of the review was limited to previous disruptions and doesn't address literature or information related to the current COVID-19 disruption. However, we understand related work is being carried out in this area so that ultimately policy and other actions by government will be based on a range of information sources.

5   Conclusion

Transport disruptions are an opportunity to advance policy goals and contribute to long-term transport behaviour change. However, this will not automatically happen - a careful, fine-grained system-level sustained response is needed, one that rapidly and proactively identifies and acts on opportunities at the right time. A range of approaches are possible, with differing levels of ambition, and New Zealand's existing policy direction for safe, sustainable and inclusive transport already provides a strong platform for change. Converting this platform into a widespread national mandate for change, as well as testing and advancing niche ideas, is the opportunity that COVID-19 brings. Lessons from previous disruptions show that New Zealand may be more successful at turning COVID-19 into an opportunity if we can balance strong government leadership with proactive and significant community engagement, especially with vulnerable groups, and quickly identify transport solutions which have synergy with economic recovery, safety and health, inclusivity, climate change and resilience goals.

The critical point is 'not to go backwards', at the very least the various forces attempting to embed the status quo of negative outcomes such as poor road safety and entrenched automobility should be identified and mitigated. More ambitiously, to counter the reversion to business as usual that is emphasised in the literature, any gains that have been made during the disruption period should be kept or extended, rather than lost or removed through 'lack of need' (eg temporary bike lanes being removed once social distancing is no longer needed). In addition, it should be ensured that the disruption and/or the policy responses do not further disadvantage vulnerable groups.

The disruption of COVID-19 is on-going and will not be New Zealand's last, particularly as climate change accelerates. Therefore, learning from this experience provides a chance to act now, but also to enhance resilience to future disruptions, in a way that reflects our transport policy goals.

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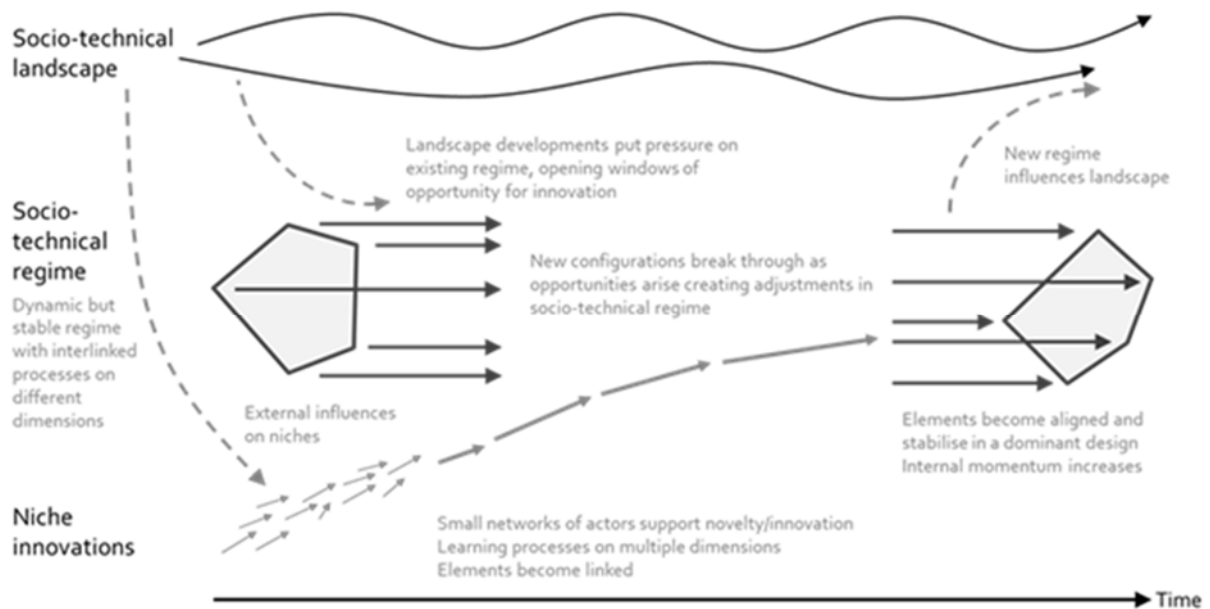
7   Appendix A

Literature review search terms.

- Disruption to transport systems effect on public policy
- Thunberg school strike effect on transport policy
- Sydney Olympics transport disruption behaviour change
- Boston bombing on transport disruption behaviour change
- 1973 oil crisis effect on transportation policy
- Travel Choices transport for New South Wales influence of Olympics
- Transport policy Sydney Olympics
- Transport legacy Olympics
- How do cities approach policy innovation
- Policy learning transportation
- Weather disruption on transport policy change
- Weather disruption on transport policy change Florida
- Impacts of volcanic ash clouds on transport policy
- Effect of 9/11 on transport policy
- Madrid train bombing effect on transport policy
- Disruption to city effect transport policy
- City disruption evidence transport policy
- Hurricane Katrina on New Orleans transport policy
- Sarin gas attack Tokyo subway impact on transport policy
- Major city disruption effect transport policy politics
- Florida flooding evidence transport policy
- Disruption to transport systems effect public policy
- Disaster disruption city effect on public transport policy resilience
- disaster disruption city effect on public transport resilience policy walking cycling
- Transport resilience and vulnerability
- Disruption leading to uptake of cycling by public
- Disruption flood earthquake epidemic effect on public transport policy walking cycling
- Kreuzberg council wider cycle lanes
- Epidemic effect on public transport policy use of public transport
- Solnit disaster transport policy social change
- Reaction to learning from disaster transport walking cycling policy
- Financial crisis transport policy reaction
- Major roadworks disruption effect on transport policy promote walking cycling
- Free public transport equity after a disaster
- Mechanisms for policy change after disaster
- Backlash to policy after disruption

8   Appendix B

Socio-technical transitions. (Field et al., 2019) Adapted from (Geels, 2011).

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