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Commuting before and after COVID-19
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ABSTRACT

Major life events like COVID-19 have the potential to change how people think about and use transport systems. The COVID-19 pandemic has created an extended period of disruption in peoples’ lives and could result in long-term changes towards travel attitudes, and use of transport services. There has previously been little research available on changes towards travel attitudes and use of domestic travel as a result of pandemics. To investigate the changes in attitudes to travel resulting from COVID-19 we distributed a survey to 787 respondents in Australia and New Zealand asking about car use, car sharing, public transport, and air travel before, during, and after COVID-19 travel restrictions. The results showed attitudes towards travel were negatively affected, particularly attitudes towards public transport and international air travel. Further, although respondents indicated some recovery in attitudes when asked to consider when travel restrictions were removed, they did not recover to the levels of positivity seen pre-COVID. There were slight differences between the two countries in their post-COVID attitudes, possibly due to their different experience of travel restriction. Both countries, however, may be useful as a preview for the rest of the world given the early cessation of the COVID-19 pandemic at the time of the survey.

Introduction

We choose our travel mode for commuting to work or school nearly every day. Inasmuch as we repeat the same journeys, under the same circumstances, the choice becomes a matter of habit rather than deliberation, we get in the car, hop on a bus, or grab the bike (Verplanken et al., 1994). Travel habits, like other habits, are generally quite resistant to change. Well-practiced habits need little attention and the presence of the environmental cues can come to initiate the behaviour with little to no conscious effort. Of course, this automaticity can result in behaviours being performed even when they no longer have the most favourable outcome (Walker et al., 2014). For example, a commuter may continue to use a car, even if a new bus lane made travelling by bus faster and more affordable than car use, simply because the well-established habit means that the commuter no longer searches or notices new information regarding their commute. Changing behaviours that occur almost automatically is difficult, and may even requires changes to the cues that surround the behaviour.

When the cues that trigger habitual travel behaviour are disrupted, people revert to deliberate decision making regarding transport mode and route (Walker et al., 2014). These disruptions provide a potential opportunity for new travel behaviours, and for new habits to form. One source of travel disruption are the travel restrictions and warnings associated with the emergence of infectious disease outbreaks, including epidemics and pandemics. Many countries use travel restrictions to limit human mobility in their contingency planning for infectious diseases (Bajardi et al., 2011). These travel restrictions may disrupt commuting habits, as often only essential businesses can be open, public transport becomes very limited, and physical distancing is encouraged. Arguably, the COVID-19 pandemic has been profoundly disruptive to many commuters and may offer a unique opportunity to proactively shape new transport habits. This is an important juncture in that the increasing population of many urban areas accentuates transport problems, and transport infrastructure is not evolving at the same pace (Abrahamse et al., 2009; Stanley, 2010).

Previous research on pandemics’ and epidemics’ effects on travel have largely focused on changes to international travel resulting from disease outbreaks, with fewer studies having researched changes to domestic travel. In addition to the obvious changes resulting from mandated reductions in travel, some segments of the population will experience significant concern and anxiety about domestic travel, both by air and by road. Some important questions to consider include: What
are the levels of this concern or anxiety; what is likely to be the long-term impacts of these concerns for the transport system; how can we alleviate these concerns without increasing adverse health outcomes? Finding the answers to these issues is important for everyone, particularly in the face of the current COVID-19 pandemic.

Research into individuals’ responses to the 2009 H1N1 influenza pandemic in Europe and Malaysia explored initial attitudes towards the disease (Goodwin et al., 2009). Large regional differences in anxiety and concern were found, with 42% Malaysians and only 5% Europeans reporting they were ‘very concerned’ about catching the flu. Further, 48% of Malaysians reported reduced public transport use, compared to 22% of Europeans. These differences were also observed in relation to respondents’ air travel plans, with 56% of Malaysian, compared to 17% of Europeans, having contemplated either cancelling their air travel plans or delaying their flights.

Another study explored Queensland (Australia) travellers’ intentions towards travel during the H1N1 pandemic in 2009 and found that more than half the sample surveyed expressed at least some concern over the virus (Leggat et al., 2010). Yet, a majority of the survey respondents indicated that they would not be willing to postpone their travel plans if they exhibited symptoms consistent with those of the H1N1 virus. This finding suggests that at least in the case of the H1N1 pandemic and the sample of respondents surveyed, their reported concern about the virus did not necessarily result in intended changes to their mode of transport.

Compared to other pandemics, the unique challenges of COVID-19 included its fast global spread and large numbers of infected people who were asymptomatic (Hendrickson and Rilett, 2020). What quickly became apparent was that the effect of the COVID-19 pandemic would be long-lasting. COVID-19 has had human and economic costs that far exceed most previous pandemics (1.5 m dead as of this writing, compared to 284,00 for H1N1 and the 1.1 million dead from the 1957–58 Asian Flu pandemic). The effects of COVID-19 will likely be experienced in the longer-term in relation to transport systems and the demand for the use of such services, including public transport and air travel.

Research in the United Kingdom (UK) suggested that many public transport users and car users planned to switch transport modes when the COVID-19 lockdown restrictions were lifted (Harrington and Hadjiconstantinou, 2020). Harrington and Hadjiconstantinou (2020) suggested that one potential positive outcome of the lockdown period and more negative attitudes towards public transport was that such happenings may motivate people to walk or cycle to work. The findings of their survey showed 20% of public transport users and 10% of car users had intentions to cycle or walk more as a means of travel after restrictions had been removed. However, the UK government discouraged the use of public transport options during lockdown. There are concerns that this discouragement may result in long-term impacts to the use of public transport as seen in Taiwan following the SARS pandemic. In this instance, public transport use did not return to pre-SARS levels until close to 5 months after the last recorded SARS related death (Wang, 2014).

There are also concerns that some public transport users would be more inclined to increase car use (Harrington and Hadjiconstantinou, 2020). Research shows that increased car use occurred in the United States (US). A survey administered during April 2020 had 14,000 participants answer questions around their private and public use of transport. The results found 17% of respondents indicated they intended to use their personal vehicle more often because of the COVID-19 virus. Additionally, 20% of respondents who indicated that they were regular users of public transport before the pandemic said they will no longer use these public transport services, with a further 28% indicating they intended to reduce their use.

It is an open question how the COVID-19 will change the world’s travel habits. Certainly, research has shown that the stronger a habit is the more difficult it is to change (Verplanken et al., 1994). A study exploring the impacts on transportation mode associated with relocating one’s home found participants who reported strong transportation habits were less likely to change their transport mode during the relocation (with such relocation representing a major life event) (Zarabi et al., 2019). The study also found the strength of travel habits was directly related to people’s willingness to change their travel, such that strong habits were unlikely to change without an accompanying willingness to change, even after a major life event. There is also evidence to suggest that behavioural automaticity underlying travel behaviour does not immediately cease, but is more likely to weaken over time as the new travel habit strengthens (Walker et al., 2014). Such findings suggest that time plays a critical component to habit maintenance and change as the original habit tendencies are still present during the disruptive period and can be susceptible to reinstatement. In the case of COVID-19 we do not know is whether it will result in long-term change to the current transport use, or if travel behaviour will revert back to levels seen prior to COVID-19 at the end of the travel restrictions associated with the pandemic.

The current study

The current study investigated people’s attitudes and intentions towards everyday travel when COVID-19 travel restrictions have been eased to allow for domestic travel, and when restrictions have been removed to allow for domestic and international travel. This survey was initiated while New Zealand and Australia had instituted travel restrictions, a strict nationwide lockdown in the case of New Zealand (see Fig. 1 for a timeline), with data collection after most domestic travel restrictions had been removed. The study was submitted for ethical review in both New Zealand and Australia, and data collection began in each country shortly after ethical approval.

The goal was to assess New Zealand and Australian residents’ reported attitudes and intentions towards using private transport, public transport, and air transport, and compare them to their reported levels prior to COVID-19. New Zealand and Australia’s response to, and effects of the pandemic were somewhat different from the USA and UK in relation to the duration of the outbreak and restrictions on their transport systems, and the shorter duration in New Zealand and Australia provides an opportunity for an early look at likely outcomes elsewhere.

The added benefit of having survey data collected in both Australia and New Zealand was that the people are quite similar, yet the experience of lockdown was slightly different for New Zealand and Australia. New Zealand had an early and strict lockdown and declared a national state of emergency on 25 March 2020. Australia passed through a number of stages of lockdown beginning at about the same time, with some differences between the states. Australia, with a larger population, and travel between states (as compared to the geographical isolation of NZ) had a more complex lockdown regime. Both countries, however, largely eliminated or curtailed the pandemic spread by August (with some exceptions), much sooner than countries elsewhere in Europe and the Americas.

Research question

As mentioned previously, the fundamental question we explored is how the COVID-19 pandemic affected attitudes towards, and intentions to use transport. We included private and public road transport as well as air transport. While we did not have any specific predictions, we were interested in the attitudes prior, during, and after the travel restrictions associated with the COVID-19 pandemic.

Method:

Design

A convenience sample (non-stratified) with an incentive was used to explore attitudes and intentions towards travel prior to and after COVID-
19. In New Zealand, the survey advertising and responses were overseen by the University of Waikato. In Australia, these were overseen by the Queensland University of Technology. Respondents in both countries were recruited by means of advertisements on social media and email. The advertisements gave a brief description of the subject of the survey (i.e., attitudes towards travel before and after COVID-19) and included an internet link to the survey. All participants who completed the anonymous survey had the option to provide their email address in order to be included in the prize draw. The New Zealand and the Australian survey held separate prize draws with 14 $50 vouchers allocated to each country.

There were similarities in the way the countries approached the pandemic, such as restrictions on indoor gatherings that occurred at similar time points. Fig. 1 presents a timeline outlining some of the important COVID-19 event dates for New Zealand and Australia.

Participants

To be eligible, participants were required to hold a New Zealand restricted or a full driver licence or Australian provisional or open licence, be over 18, and must have been currently residing in either New Zealand or Australia.

New Zealand sample: A total of 506 eligible participants completed the survey (206 male). The participants’ ages ranged from 18 to 83 years, with a mean age of 44.71 years. For ethnicity of the sample, see Table 1.

Australian sample: A total of 281 eligible participants completed the survey (118 male). The participants’ ages ranged from 18 to 85 years, with a mean age of 49.70 years. For ethnicity of the sample, see Table 1.

Although the surveys did not attempt to be explicitly representative of the populations of the two countries, there was generally good correspondence with the populations’ demographics. In both samples, the age was somewhat older than the country medians (NZ MDN = 37.2, Aus MDN = 38.0); and NZ European and Australian European respondents were over-represented in the samples (Australian Bureau of Statistics, 2020; StatsNZ, 2020). In NZ the number of respondents identifying as Asian and Pasifika were under-representative of the population (15.3% and 8.1% respectively).

Materials and measures

The survey questions related to attitudes towards transport modes and intended use of travel modes were specifically created for this study to answer the question of how the COVID-19 pandemic affected attitudes and intentions to use transport. The survey included questions to measure participants’ attitudes towards a range of travel modes, including individual car use, carpooling, public transport, and domestic and international air travel, pre- and post-COVID-19 restrictions. There were three contexts or timeframes created to assess attitudes including prior to COVID-19 restrictions, when restrictions have been eased, and when restrictions have been removed.

For consistency, two phrases were used when answering questions surrounding attitudes and travel use before COVID-19. The phrase “prior

Table 1

| Ethnicities              | New Zealand respondents | Australian respondents |
|-------------------------|-------------------------|------------------------|
| New Zealand European    | 77.1                    | 4.5                    |
| Maori                   | 12.7                    | 0.3                    |
| Australian              | 1.8                     | 71.7                   |
| Indigenous Australian   | 0.2                     | 0.6                    |
| Other European          | 8.9                     | 12.4                   |
| Pasifika                | 2                       | 0                      |
| Chinese                 | 1.4                     | 2.3                    |
| Indian                  | 2                       | 1.6                    |
| Other                   | 8.4                     | 6.5                    |

Table 1 shows the Ethnicity of the New Zealand and Australian samples reported as a percentage.
to COVID” asked participants to answer as they would have answered just before concerns and restrictions were put in place as a result of the COVID-19 virus. The phase “in the 12 months before COVID-19” asked participants to answer in relation to the 12-month period before COVID-19 concerns and restrictions and, indeed, prior to any experience or knowledge of COVID-19.

For the section regarding when restrictions have eased, it was outlined that participants should report their likely attitudes towards travel at a time when restrictions have eased, and travel is allowed domestically. In this section, participants were also asked about their intentions to change use of the travel modes. Questions related to attitudes to international air travel post-Covid-19 were not included as this form of travel was still not possible for most New Zealand and Australia residents (without a 2-week quarantine upon arrival). The analysis of attitudes regarding when restrictions had been removed asked participants to report their likely attitudes once COVID-19 travel restrictions have been removed, and travel is allowed both domestically and internationally.

Response options to the questions related to travel attitudes were reported on a Likert scale with five points: extremely positive, somewhat positive, neither positive nor negative, somewhat negative, and extremely negative. Questions related to use of transport were similar, and asked participants to report their use over the 12-month period before concerns of COVID-19. Participants were then asked to compare their use before COVID-19 to when restrictions have been eased, and when restrictions have been removed. Responses were recorded on a Likert scale with five options: moderate increase, slight increase, no change, slight decrease, moderate decrease.

Procedure

The New Zealand data collection began on the 22nd of July and ended on the 7th of August 2020. The New Zealand portion of the study was advertised online through social media sites, and email invitations were sent to a database of previous participants from the University of Waikato’s Transport Research Group. The Australian data collection began on 7th August and closed on the 1st of September 2020. During the ethics review process, the format of the survey administered in Australia was changed slightly different (e.g., the demographic information was moved to the beginning of the survey and psychological distress information was added) in order to comply with the ethics committee’s recommendations.

Advertisements promoting the study included a link to the survey which was administered using Qualtrics. Participants were provided with an information section that outlined the aim of study was to explore attitudes towards travel before and after the COVID-19. Participants were informed that they were free to withdraw from the study at any time and that by continuing with the survey they were providing informed consent for the information gathered to be analysed and the study’s findings disseminated. The full survey contained 93 questions and took about 20–25 min to complete.

Results

Public transport attitudes

We addressed the main research question How has the COVID-19 pandemic affected attitudes towards, and intentions to use transport? by examining survey respondents’ attitudes towards different travel modes; including public transport, car use, and air travel. Beginning with public transport, respondents’ attitudes towards public transport were compared at three time points; namely, prior to the COVID-19 outbreak, after COVID-19 travel restrictions had eased, and their likely attitudes towards public transport after all restrictions had been removed. Fig. 2 shows the respondents’ mean ratings for these questions separated by country.

Visual inspection of the means show that participants from the New Zealand and Australian samples showed similar patterns in their attitudes towards public transport. As can be seen in Fig. 2, Australian participants showed slightly more positive attitudes towards public transport than the New Zealand sample prior to COVID-19 (M = 2.62 for NZ, M = 2.35 for AUS). Both samples reported more negative attitudes for the time when restrictions had eased (3.07 for NZ, 3.41 for AUS), improving slightly when all travel restrictions had been removed (2.98 for NZ, 3.19 for AUS).

A 2 (country) by 3 (restriction phase) ANOVA was used to compare participants’ attitude ratings between countries and at each phase of restriction. The results showed a significant main effect of restriction phase [F(2,1570) = 241.420, p < .001, ηp² = 0.235], but no significant difference between the countries [F(1,785) = 1.708, p = .192, ηp² = 0.002]. There was, however, a significant interaction between country and phase [F(2,1570) = 38.947, p < .001, ηp² = 0.047]. Subsequent post-hoc comparisons revealed a difference in the way the two countries responded to the post-COVID-19 restrictions with a greater increase in negative ratings towards public transport for respondents in Australia (mean change of −1.057, 95% CI = −1.238 to −0.875) compared to respondents in New Zealand (mean change of −0.453, 95% CI = −0.564 to −0.341), and a subsequently greater increase in positive ratings for when restrictions had been removed (a mean difference of 0.217 for Australia, 95% CI = 0.103 to 0.329, and a mean difference of 0.097 for New Zealand, 95% CI = 0.025 to 0.169).

To investigate the possibility that respondents’ familiarity with public transport might influence their attitudes towards it, we separated the portion of the sample who said they were regular public transport users. Regular users were defined as those that indicated they used public transport at least “a few times a month” in the 12 months before COVID-19 (n = 71 in New Zealand, n = 101 in Australia). Proportionally, the Australian sample had a higher percentage of regular public transport users (35.9%) than the New Zealand sample (14.0%) which may have contributed to the difference in ratings observed for the New Zealand and Australian samples’ ratings of public transport for the “prior to COVID” period.

Fig. 3 shows the results of this analysis; and although regular users had similar ratings in New Zealand (M = 1.90) and Australia (M = 1.88), for the prior to COVID period, they were more positive than the non-regular users in New Zealand (M = 2.74) and Australia (M = 2.61), for the same period. As can be seen in Fig. 3, both countries showed a similar pattern of attitudes, regular public transport users were less negative at each of the phases of restriction. A 2 (country) by 2 (regular vs non-regular user) by 3 (restriction phase) ANOVA revealed that the difference in ratings was significant with a two way interaction between restriction phase and country; [F(2,1566) = 26.013, p < .001, ηp² = 0.032] and a two way interaction between restriction phase and

![Fig. 2. Mean attitude ratings towards public transport at each phase of travel restriction for each country. Whiskers indicate 95% confidence intervals.](image-url)
public transport use [$F(2,1566) = 10.437, p < .001, \eta^2 = 0.013$]. There was no interaction between country and frequency of use [$F(1,785) = 2.34, p = .126, \eta^2 = 0.003$] or higher-order interaction between country, frequency of use, and restriction phase; [$F(2,1566) = 1.23, p = .294, \eta^2 = 0.002$].

Next, we wanted to know if changes occurred in intentions to use public transport when COVID-19 travel restrictions had been eased, and when travel restrictions had been removed. We specifically looked at regular users’ intentions to change their transport use (to make any changes in intentions easier to see). Regular users’ intentions to use public transport showed decreases in use at the eased restriction phase, followed by some recovery in intentions to use public transport when restriction have been removed. As shown in Fig. 4, respondents who regularly used public transport in the New Zealand sample reported less change in their intentions to use public transport between restriction phases, with a greater difference between the phases for the Australian respondents. These observations were reflected in the results of a 2 (country) by 2 (restriction phase: eased, removed) ANOVA which revealed a significant difference between restriction phases [$F(1,170) = 21.203, p < .001, \eta^2 = 0.111$], but no significant interaction between country and restriction phase [$F(1,170) = 2.54, p = .113, \eta^2 = 0.015$]. There was an overall main effect of country [$F(1,504) = 10.836, p = .001, \eta^2 = 0.060$] which indicated that country of residence influenced the respondents’ intentions to use public transport.

**Use of private cars**

Another shared transport mode that we examined was carpooling. Respondents were asked to rate their attitudes towards carpooling for each restriction phase. The mean ratings for these questions are shown in Fig. 5, grouped by country of residence. Similar to the attitudes towards public transport, respondents in the New Zealand and Australian samples had similar patterns in their attitudes towards carpooling. As shown in Fig. 5, both samples reported positive attitudes prior to COVID-19 ($M = 2.57$ for New Zealand, $M = 2.58$ for Australia), with attitudes becoming less positive at a time when restriction have eased ($M = 2.90$ for New Zealand, $M = 3.23$ for Australia), showing some movement towards recovery at a time when restrictions have been removed ($M = 2.87$ for New Zealand, $M = 3.14$ for Australia). A 2 (country) by 3 (restriction phase) ANOVA was used to compare attitude ratings between New Zealand and Australia at each restriction phase. The results indicated that the difference between restriction phases was significant; [$F(2,1570) = 151.746, p < .001, \eta^2 = 0.162$]. There was also a significant difference between countries [$F(1,785) = 8.728, p = .003, \eta^2 = 0.011$], and a significant interaction between country and restriction phase [$F(1,785) = 15.435, p < .001, \eta^2 = 0.019$].

As we did with public transport, we investigated the possibility that frequent carpool users might have different attitudes to respondents who rarely carpool. The influence of regular use on attitudes towards carpooling was analysed using similar methods to those used to analyse the public transport data in that we divided the sample into respondents who regularly were carpool passengers and those who were not. Regular users were defined as those who were passengers at least a few times a month ($n = 379$ for New Zealand, $n = 196$ for Australia), with other respondents defined as non-regular users in relation to carpooling. The New Zealand sample had a higher proportion of regular carpool users (74.9%) than the Australian sample (69.8%).

Regular and non-regular users’ attitudes showed a similar pattern in both the New Zealand and Australia samples (see Fig. 6). A 2 (country) by 2 (regular, non-regular users) by 3 (restriction phase) ANOVA was...
conducted to compare carpooling attitudes between countries, and frequency of use, over the three restriction phases. Regular carpool users reported more positive ratings towards carpooling than non-regular users at each phase of restriction \( F(1,783) = 16.831, p < .001, \eta_p^2 = 0.021 \). There was also a significant main effect of restriction phase \( F(2,1566) = 122.008, p < .001, \eta_p^2 = 0.135 \). As well as a main effect of country \( F(1,783) = 6.213, p = .013, \eta_p^2 = 0.008 \). Additionally, there was a significant interaction between restriction and country \( F(2,1566) = 11.769, p < .001, \eta_p^2 = 0.015 \). As shown in Fig. 6, this interaction was due to a greater drop in Australian sample’s attitudes, compared to the New Zealand sample.

Our survey did not measure intentions to use carpooling separately, instead we asked about intentions regarding car use in general. Cars were the most frequently used travel mode and 95% of respondents reported their car use prior to COVID-19 as at least a few times a month (NZ = 96.8%, AUS = 95.4%), with 82% reporting most of the week or more, and 67% of the sample reporting they use a car almost daily.

We compared respondents’ intentions to change their car use during the eased and removed restriction phases. Due to the high use of cars overall, all respondents were included in the analysis (it was a requirement to have a driver’s licence to participate). As shown in Fig. 7, changes in intended car use were not large with means for the New Zealand sample being close to no change (Eased: \( M = 3.02 \), Removed: \( M = 2.93 \)). The ratings of the Australian sample were higher than the New Zealand sample at the eased and removed restriction phases (Eased: \( M = 2.64 \), Removed: \( M = 2.57 \)). A 2 (country) by 2 (restriction phase) ANOVA indicated there was a significant main effect of country; \( F(1,785) = 41.383, p < .001, \eta_p^2 = 0.050 \). There was also a significant main effect of restriction phase \( F(1,785) = 6.497, p = .011, \eta_p^2 = 0.008 \) but no significant interaction between restriction and country \( F(1,785) = 0.080, p = .777, \eta_p^2 = 0.000 \).

Respondents’ ratings of their attitudes towards domestic air travel showed a similar pattern to other modes of domestic transport (see Fig. 8). Both New Zealand and Australian respondents’ attitudes were the most positive prior to COVID-19 (\( M = 1.98 \) for New Zealand, \( M = 1.87 \) for Australia), becoming more negative when restrictions have eased (\( M = 2.65 \) for New Zealand, \( M = 3.06 \) for Australia), and recovering somewhat at a time when restrictions have been removed (\( M = 2.54 \) for New Zealand, \( M = 2.90 \) for Australia).

A 2 (country) by 3 (restriction phase) ANOVA was used to compare attitude ratings regarding domestic air travel. The results showed a significant main effect of restriction phase \( F(2,1568) = 364.07, p < .001, \eta_p^2 = 0.317 \). There was also a significant main difference between countries \( F(1,784) = 11.53, p = .001, \eta_p^2 = 0.014 \) and a significant interaction between restriction phase and country \( F(1,1568) = 14.807, p < .001, \eta_p^2 = 0.037 \). The source of the significant interaction appeared to be a greater recovery of positive attitudes on the part of the Australian respondents.

Examining whether respondents who frequently used domestic air travel reported different attitudes to those who were not frequent users required a somewhat different approach to other transport modes since air travel is typically not as frequently used as public transport. We considered recent users domestic air travel rather than the frequency of repeated air travel. Recent users were defined as respondents who reported that they used domestic air travel during the 12 month period before COVID-19 (New Zealand \( n = 333 \), Australia \( n = 194 \)). Both
samples had a similar percentage of domestic air travel users (65.8% for New Zealand, 69.0% for Australia). An ANOVA failed to reveal any significant difference in attitudes between respondents in the two countries when separately comparing the ratings of recent users \( F(1,525) = 0.552, p = .458, \eta^2_p = 0.001 \) and non-recent users \( F(1,258) = 1.352, p = .246, \eta^2_p = 0.005 \).

Attitudes towards domestic air travel appeared to be affected more negatively in the Australian sample than the New Zealand sample (see Fig. 9). To compare the ratings of domestic air travel across the two countries, a 2 (country) by 2 (recent, non-recent user) by 3 (restriction phase) ANOVA was used. This difference was significant as indicated by a two-way interaction between restriction phase and country; \( F(2,1564) = 24.892, p < .001, \eta^2_p = 0.031 \). Overall, there was a significant effect of country \( F(1,782) = 9.620, p = .002, \eta^2_p = 0.012 \). There was also a significant interaction between restriction phase and domestic air travel use \( F(2,1564) = 6.403, p = .002, \eta^2_p = 0.008 \) which suggests that recent users’ attitudes were affected more than non-recent users. Further, there was no interaction of users group and country \( F(1,782) = 0.886, p = .347, \eta^2_p = 0.001 \), or higher order interaction of restriction, country, and domestic air travel use; \( F(2,1564) = 0.179, p = .836, \eta^2_p = 0.000 \).

We then looked at intentions to use domestic air travel in a similar manner to that of other transport users, with changes in intended use reported. Recent users’ ratings of their intentions to use domestic air travel are shown in Fig. 10. As can be seen, there was an increase (recovery) in intentions to fly domestically once restrictions were removed. The New Zealand sample reported very little change in use (Eased: \( M = 3.11, \text{Removed } M = 2.94 \)), with the Australian sample reporting more change (eased: \( M = 3.47, \text{removed } M = 3.19 \)). A 2 (country) by 2 (restriction phase) ANOVA indicated that the difference between restriction phases \( F(1,525) = 42.235, p < .001, \eta^2_p = 0.074 \), and a significant difference for country \( F(1,525) = 13.679, p < .001, \eta^2_p = 0.025 \), but no interaction between country and restriction phases \( F(1,525) = 3.131, p = .077, \eta^2_p = 0.006 \).

International air travel

Lastly, we looked at attitudes and intentions to use international air travel. Respondents were asked to rate their attitudes towards international air travel prior to COVID-19, and their likely attitudes towards international air travel when all restrictions had been removed. The mean ratings to these questions are shown in Fig. 11. As shown in Fig. 11, the New Zealand sample had slightly more positive attitudes towards international air travel than the Australian sample prior to COVID-19 (\( M = 3.85 \) for New Zealand, \( M = 3.99 \) for Australia) as indicated by a univariate ANOVA \( F(1,784) = 4.401, p = .036, \eta^2_p = 0.006 \). A 2 (country) by 2 (restriction phase: prior, removed) ANOVA indicated that the difference between restriction phases was significant; \( F(1,784) = 518.468, p < .001, \eta^2_p = 0.698 \). There was also a slight but significant difference between the countries \( F(1,784) = 4.674, p = .031, \eta^2_p = 0.006 \), but no interaction between country and phase \( F(1,784) = 0.001, p = .974, \eta^2_p = 0.000 \).

Further, the New Zealand sample had a higher percentage of recent international air travel users (62.1%) than the Australian sample (51.3%). Similar to domestic travel modes, an analysis was conducted to examine whether respondents’ use of international air travel prior to COVID-19 influenced their pattern of ratings. In a similar manner to domestic air travel, respondents who reported they had travelled internationally in the 12 month period before COVID-19 were defined as recent users, and those who did not as non-recent users in relation to international air travel. The results of this comparison are shown in Fig. 12.
There was no appreciable difference between recent international air travel users’ attitudes between the New Zealand and Australian samples ($M = 2.76$ for New Zealand, $M = 2.80$ for Australia) ($F(1,456) = 0.098$, $p = .754$, $\eta^2_p = 0.000$). Nor was there any appreciable difference between countries for the non-recent international travellers ($M = 3.24$ for New Zealand, $M = 3.40$ for Australia) ($F(1,326) = 1.360$, $p = .244$, $\eta^2_p = 0.004$). Compared to attitudes reported prior to COVID-19, both recent and non-recent users of international air travel attitudes reported less positive attitudes for the removed restriction phase. Further, recent international air travel users’ attitudes remained significantly more positive ($M = 2.77$) than non-recent users’ ($M = 3.31$); $F(1,784) = 35.064$, $p < .001$, $\eta^2_p = 0.043$. Similar to public transport attitudes, the higher proportion of recent users in the New Zealand sample may have contributed to the overall higher ratings towards international air travel seen prior to COVID-19.

Lastly, recent users’ intention to use international air travel were examined. Recent users in the New Zealand and Australian samples had similar means intentions to use international air travel when restrictions have been removed ($M = 3.31, SD = 1.205$ for New Zealand, $M = 3.19, SD = 1.281$ for Australia), with both countries indicating some decrease in use of international air travel when restrictions have been removed (compared to their prior use). An independent sample $t$-test of recent international air travel users failed to find a significant difference between the means of the New Zealand and Australian samples; $t(456) = 0.899$, $p = .369$. The distribution of the New Zealand and Australian samples were also similar (see Table 2). Over 40% of respondents in both samples reported they intended to reduce their use of international air travel, approximately 30% reporting no change, and roughly 26% (New Zealand) to 30% (Australia) of respondents reported intentions to increase their use of international air travel.

**Discussion**

This study examined how the COVID-19 pandemic affected attitudes towards, and intentions to use transport in New Zealand and Australia. First, and perhaps not surprisingly, travel attitudes were negatively affected by COVID-19. Attitudes towards public transport, carpooling, domestic air travel, and international air travel were all negatively affected. Across travel modes, the Australian sample consistently reported more negative attitudes towards domestic travel options when compared to the New Zealand sample. New Zealand and Australian samples have very similar attitudes toward international air travel prior to, and when restrictions have been removed. There were undoubtedly several reasons for this difference based in both the management of the pandemic and the domestic travel options available to respondents in the two samples. It is difficult to compare the samples to other countries in the region due to the continuation of lockdowns in those countries and/or the very limited domestic travel available. As of this writing there had not been any comparable surveys reported in the literature.

Attitudes were significantly less positive when COVID-19 restrictions were in place, with some recovery occurring when restrictions were removed. Research by the New Zealand Transport Agency on concerns about infection and transmission showed declines in concerns generally when restrictions were removed and shown to increase as new cases were confirmed (Waka Kotahi NZ Transport Agency). We believe this fluctuation shows the two edged-sword of the restrictions and the attitudes towards travel. Our analysis also found that regular users of public transport had more positive attitudes towards public transport prior to COVID-19 than those who were not regular users. This was in line with previous research on public transport attitudes in New Zealand. The findings suggested direct contact with public transport related to less negativity towards public transport (Murray et al., 2010). Recent users of domestic and international air travel also showed more positive attitudes than those who had not recently used these travel modes.

In regard to country differences in the changes in the intentions to

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**Table 2**

Recent users’ intentions to use international air travel at the removed restriction phase, grouped by country (percentage of respondents).

| Response option      | New Zealand ($n = 314$) | Australia ($n = 144$) |
|----------------------|-------------------------|------------------------|
| Moderate increase    | 7.6                     | 11.1                   |
| Slight increase      | 18.2                    | 19.4                   |
| No change            | 30.9                    | 29.2                   |
| Slight decrease      | 22.6                    | 19.4                   |
| Moderate decrease    | 20.7                    | 20.8                   |
use various travel modes, compared to the Australian respondents, the New Zealand respondents reported only minor changes to their intentions to use domestic air travel and car use when restrictions had been eased. The most prominent change was in the intentions to use public transport, which saw some decrease when restrictions had eased, and some recovery at a time when restrictions were removed. Further, research has shown that public transport in New Zealand has only partially recovered, with public transport ridership increasing to approximately 75% of the levels of public transport use seen prior to COVID-19 (Waaka Kotahi NZ Transport Agency).

The Australian sample reported greater intentions to change their use of domestic travel modes than the New Zealand sample. The Australian sample showed notable intentions to increase car use and decrease their use of public transport and domestic air travel even at a time when restrictions have been removed. This would suggest that the Australian transport system might take more time to return to similar levels of public transport seen prior to COVID-19. The recovery in intentions to use public transport when restrictions have been removed suggests that there will be movement towards levels seen prior to COVID-19, however, some of these changes may become part of the ‘new normal’ and the effects will extend far longer than concerns for the virus.

While New Zealand and Australia respondents differed on some of their intentions to use domestic travel modes, both samples reported similar intentions to use international air travel after restrictions have been removed. Indeed, when a quarantine-free “travel bubble” opened between the two countries on 19 April 2021, the uptake by travellers in both directions was immediate with 50,000 travellers in the first 9 days (30,000 from Aus to NZ) reflecting what was termed a pent up demand to travel (2021).

What does this mean for the future?

The findings of this study make it clear that the COVID-19 pandemic has had suppressed travel across all modes effects far beyond that seen in previous pandemics. While part of this is due to explicit travel restrictions, we can see some post-restriction changes, particularly as regards use of public transport. Public transport use might take some time to revert to levels seen prior to COVID-19, but it may also be the case that the return to normal plateaus at a lower level as we come into what is known as the “new normal”.

The Australian sample’s intentions to reduce public transport use and increase car use should be explored further to understand what implications this might have for the transport system. Public transport use in both countries has remained lower many months after the removal of most domestic travel restrictions. It may take additional time, information, and incentives for people to become comfortable in returning to using public transport modes. Further, as the Australian sample had a larger proportion of regular public transport users and reported larger decreases in use, this is particularly detrimental. Finally, both Australia and New Zealand, have had only minor outbreaks when compared to countries such as China. Research in China has suggested much larger increase in car use with an intention to increase regular car use to 66%, up from 34% prior to COVID-19 (Dunning and Nurse, 2021). Based on our findings, and modelling studies of the effects of COVID-19 on the tourism industry across 185 countries we can suggest that the pandemic will have negative effects beyond those that occurred during previous pandemics (Skare et al., 2021). The policy implications of these effects include the likely need to encourage and incentivise a return to public transportation, albeit international travel for tourism appears poised to return without incentives.

Limitations

One limitation of this study was that it assessed respondents’ attitudes and their intentions towards various travel modes rather than people’s actual use. A second limitation of this study was that both New Zealand and Australia continued to have cases of community transmission reported. While the number of COVID-19 cases has lowered, there is potential for more waves of the virus. We cannot be sure how additional waves might affect participants’ attitudes and intentions towards travel. It is an open question whether NZ and AUS differences were due to time lags in controlling the virus, or other factors such as New Zealand’s geographical isolation, smaller population size, or nationwide lockdown.

Future research

This survey did not access attitudes towards active transport modes, such as walking or cycling. Research overseas has suggested that there may be some increases in these modes of travel as a result of concerns regarding COVID-19. Further, as this study only included licenced drivers, it would also be of interest to explore whether attitudes are different for those that are unable to drive themselves. Research may also want to explore attitudes and change in use of hireable shared transport such as car sharing schemes, bike, and electric scooter hiring.

This study also did not look at the typology of travel and cannot make suggestions regarding changes to the number of trips, combining of trips or distance travelled. Future research may want to examine if the pattern of travel has changed. Further, it is unclear why some car users increased their use, and what purpose this served e.g., more travel for social events, shopping etc, local tourism. Research may also want to consider how domestic travel for recreational purposes (e.g., holidays) have been influenced.

Data availability

The data analysed during the this are not publicly available due lacking participant consent for open data-sharing, but are available from the corresponding author on reasonable request.

Funding

This research was self-funded by the Transport Research Group and Centre for Accident Research and Road Safety-Queensland.

Ethical approval

All participant recruitment and test procedures were approved by the Human Research Ethics Committee at the University of Waikato and the Office of Research Ethics & Integrity at Queensland University of Technology.

Author contribution

This research was jointly conceptualised and conducted by the first two authors (Thomas and Charlton). Additional comments and input to the survey and procedure was provided by Lewis and Nandavar. The first draft of this manuscript was prepared by the first author (Thomas) and revised by the second author (Charlton).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The research described in this manuscript was undertaken by the first author (FT) in partial fulfilment of a Master of Social Sciences degree in Psychology and was supervised by the second author (SC). The manuscript was jointly prepared by all four authors. This research did not
receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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