Free Wi-Fi on public transport – will it make a difference to urban travel?

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Abstract

The benefits of free Wi-Fi in the hospitality industry is well recognised. When it comes to travel, however, it is less clear to what extent free Wi-Fi on trains and buses attracts and keeps passengers using and being satisfied with public transport. Through a sample survey of mostly younger travelers in Perth, this paper aims to contribute to a better understanding of the expectations and potential benefits to existing and potential public transport passengers of providing free Wi-Fi on public transport. It was found that free Wi-Fi does have the capacity to increase public transport usage and that if free Wi-Fi were to be introduced, public transport users would connect to it, especially those travelling further. Effectiveness is, however, negatively impacted by context constraints such as requirements to provide personal detail to sign up or to view ads, especially in the case of short journeys. It also emerged that 4G mobile data technologies pose a serious threat to the long-term success of free Wi-Fi on public transport.

1.Introduction

With the development of communication technologies, we currently live in an increasingly connected society. This has created a significant dependence on technologies that facilitate constant connection to the internet. With 77 percent of Australians currently owning a smartphone (Business Insider 2016), the ability to access the internet is no longer restricted to just the home and office. Public Wi-Fi hotspots are an increasingly important way of connecting to the internet when on the move. Furthermore, the number of smartphone users that are connecting to Wi-Fi has increased significantly (Wireless Broadband Association [WBA] 2015), supporting the need for broad and reliable network coverage. Free Wi-Fi is now becoming increasingly widespread with many cities providing internet access throughout high traffic areas. A survey of over 1000 mobile device users from 15 global markets including Australia, found that access to a strong Wi-Fi signal is a deciding factor when choosing a hotel/holiday/hostel rental (71 percent), transport hub for traveling and/or commuting (46 percent), place to eat or drink (43 percent), and an airline (43 percent) (Norton by Symantec 2017). Almost half (49 percent) the respondents said the most important reason for having access to strong public Wi-Fi is so they can use Maps, Google Maps or another GPS app to get around. Yusop et al. (2011) claim that the advantages of providing free internet at fast food outlets are typically associated with general web browsing, whether that be for business or for pleasure.

When it comes to travel, a survey of metro systems worldwide showed that 77 percent provided internet access either in stations (73 percent) or on-board trains (58 percent) and that 68 percent planned to expand internet connectivity with three years (Rudnenko & Dauby

2014). Since public transport systems are usually subject to funding constraints, decision-makers require convincing evidence to prioritise investment in strategies that have the greatest positive effect on managing travel demand, making more efficient use of current transport resources and deferring the need for new infrastructure. The primary objective of travel demand management is to change mode choice behavior to reduce single-occupancy car mode share and increase public transport and active travel modes.

A range of travel demand management instruments have been identified and well-studied including improvements to alternative modes, integrating land use and transport, travel behavior change programs, road space management, parking and taxes and charges (Babb et al.. 2016; Balcombe et al. 2004; Taylor & Fink 2003). With rapid advances in and increasing access to communications technologies, a recent strategy to add to the list of potential strategies beneficial for improving the quality of public transport, is the provision of free Wi-Fi. Although literature specifically on the effectiveness of free wireless internet on public transport travel is limited (Garikapati et al. 2016; Zheng et al. 2016), some recent studies have investigated the implications of ICT use more generally, and wireless internet use more specifically, on the propensity for public transport travel. These are largely mode choice behavior studies using econometric models, employed to test the relative effectiveness of alternative strategies to achieve mode choice change.

Positive impacts in terms of satisfaction, mode shift to public transport and increased patronage have been reported in relation to increased levels of ICT use on public transport, attributed largely to more productive use of travel time and access to real-time arrival information (Lyons & Urry 2005; Blumenberg et al. 2012; Matsumoto & Hidaka 2015). More specifically, free Wi-Fi on public transport services has been found to have positive and significant impacts on ridership and public transport mode choice in the case of rail (Banerjee & Kanafani 2008; Hartwich & Buckingham 2009; Rudnenko & Dauby; 2014 Dong et al. 2015; Rashedi et al. 2017) and bus (Twichell et al. 2008; Fischer et al. 2011). Not all studies, however, report positive impacts for public transport travel. In a study focused on Millennials travel choices in Glasgow UK, Hong and McArthur (2017) concluded that Internet use while travelling is neither associated with increased travel demand for public transport nor reduced car ownership rates. In Australia, the provision of laptop stations and wireless access did not reveal statistically significant positive effects on the utility of public transport (Zheng et al. 2016). Zhang et al. (2014) suggest free Wi-Fi only as a supplementary incentive for public transport travel while negative effects are possible if promised on-board Wi-Fi connections are poor or unstable (Bjorner 2015).

Variation in the effects of ICT use on public transport mode choice is evident in relation to socio-economic factors including income, gender, occupation and age (Zhang et al. 2006; Zheng et al. 2016; Rashedi et al. 2017). With the younger generation more likely to embrace new technologies (Schliefe 2010; Verdegem & De Marez 2011; Verdegem & Verhoest 2009, Lenhart et al. 2010), travel behavior of younger travelers is expected to be influenced by ICT more than older cohorts (Van Wee 2015; Ralph 2016). Empirical studies have shown, however, that Internet use both whilst travelling (Hong & McArthur 2017) and in terms of daily web use (Blumenberg et al. 2012) appears to have no effect on trip-making or increased public transport travel demand for younger travelers.

Most of the limited studies in relation to the effect of free Wi-Fi on travel reviewed above, are focused on understanding the relative importance of all factors influencing mode choice. Only two offered some speculation of explanatory factors. Reasons postulated for lack of positive impact of free wireless access on public transport utility for all travelers and younger travelers include fear of a fare increase to fund the free access, high penetration of smart

phones in Australia that often come with a 3G or 4G data plan makes access to wireless less appealing (Zheng et al. 2016) and ubiquitous internet use (Blumenberg et al. 2012).

Whether impacts on travel are positive or not, contextual constraints and trip characteristics influence extent of the impact (Zheng et al. 2016). Dong et al. (2015) found that the fewer the trips made per week, the less the impact, while contextual factors, such as connectivity, space constraints, noise levels and privacy concerns, also constrain impact (Axtell et al. 2008). One of the main challenges of a public Wi-Fi network is vulnerability to hacking (Henry & Luo 2002, Dhawan 2007). Level of service is a further issue. In theory, current Wi-Fi technology can provide data transfer speeds of up to 7Gbps (Cordeiro et al. 2010), however, internet speeds do not utilise this to its full advantage with the best globally being Singapore at approximately 150Mbps (Forbes 2017). Furthermore, when it comes to free public Wi-Fi speeds are reduced again. To ensure an equal service for all users, the amount of bandwidth each customer has access to, is evenly divided between those online. This means that the theoretical speeds advertised become unachievable, with speeds often dipping too low to support modern web browsing requirements. In comparison, the average download speed for 4G LTE plans in Australia is 33.76Mbps which is sufficient to complete most internet tasks away from home or office, without the bandwidth issues of public Wi-Fi. This in conjunction with the often-poor security of public Wi-Fi networks means that the user might be more likely to use their personal mobile data plan even if it costs more, as it provides an overall better browsing experience. In addition, for public Wi-Fi networks to remain free, they are typically subsidised by advertising over the network which may further alienate users.

In Perth, Australia, there is currently no free Wi-Fi provided on public transport. With patronage on the decline (PTA 2018), policy-makers are considering a range of measures to win more customers. Zheng et al. (2016, p. 190) concluded that "the potentially complex interaction effects of Wi-Fi remain unexplored" and "there is a great need to systematically investigate free Wi-Fi's … impact on rail ridership (and on triggering modal shift)", especially to provide evidence of benefit to justify the significant cost of providing free Wi-Fi on public transport.

Given the limited, conflicting and heterogeneous evidence of impact of W-Fi on public transport presented in the literature, the aim of this research is to inform the decision to provide free Wi-Fi on Perth public transport and the policy debate more generally, by exploring the potential impact of providing free Wi-Fi on public transport usage and quality of experience, with a preliminary consideration of the effects of context constraints, particularly focused on younger travelers (Millennials – born between 1980 and 2000), in the context of Perth.

This paper aims to provide insight into the following key questions:

1. Will the introduction of free Wi-Fi on public transport promote increased public transport usage?
2. How will the introduction of free Wi-Fi benefit the public transport user?
3. Are the potential benefits of free Wi-Fi reduced with the popularity of mobile data plans (4G)?

2. Methodology

Primary data in the form of a sample survey was used to inform the research (see questionnaire at Appendix A). The surveys were distributed online using Qualtrics as the host between the beginning of March and end of April of 2018 with 101 total useable responses. The survey was promoted initially through university, personal and sporting club networks to

capture a large proportion of Millennials (aged 18-39 in 2018), with snowballing encouraged. Ethics approval was obtained.

The survey was split into four sections each addressing important areas of the research. The first section aimed to establish a base level of demographical information by asking respondents their age, occupation, whether or not they are provided with a commuting allowance, and whether they use public transport regularly for their daily commute. These questions were asked as they can be used as categories for analysis, and to help find possible trends.

The second section of the survey was targeted towards respondents who answered no to question 4 (For your daily commute from and to home, do you use public transport at least 3 times a week?). By targeting these people, the research aims to determine why people don't use public transport, and if the introduction of free Wi-Fi would act as an incentive for them to start using it.

The third section of the survey targeted people that do use public transport (at least once a month) and aimed to develop an understanding of how free Wi-Fi would be used were it to be introduced. This was done by firstly asking the respondents if they would connect to the Wi-Fi were it available. As one of the forecast benefits of the network is access to peoples contact details through a Wi-Fi login, and the ability to advertise over the network, respondents were then asked if they would be willing to agree to these terms to use the network. Respondents were also asked how they currently use the internet when travelling (assuming a mobile data connection as the only method to connect) versus how they would use the internet with Wi-Fi to develop insight into how internet usage might change. Finally, respondents were asked what public transport service they predominantly use (bus, train, or ferry) and then average length of their journey to help find a relationship between the way people travel and their potential use of free Wi-Fi.

The final section of the survey addressed general questions about the use of free Wi-Fi addressing the expectations of free Wi-Fi should it be introduced by asking people to rank various aspects of a Wi-Fi network by importance to them, and if the introduction of free Wi-Fi would improve their overall experience on public transport.

3. Results

3.1. Characteristics of respondents

Largely as a result of the sampling approach used, respondents were primarily in the age group 20-29 (75 percent) (Figure 1) with 37 percent of respondents being students. This means that there is a bias in the data towards younger people who could be more knowledgeable about technology, and more inclined to use the Wi-Fi if it is provided. This would mean that Wi-Fi usage statistics generated by this research might be higher than if the data had a more realistic age distribution. Furthermore, as the survey was only distributed online people without internet access were excluded. This is important to consider for the analysis as it means only people with internet access and the technical know-how to complete the survey were able to respond.

Figure 1: Percentage distribution of ages of respondents (n = 101)
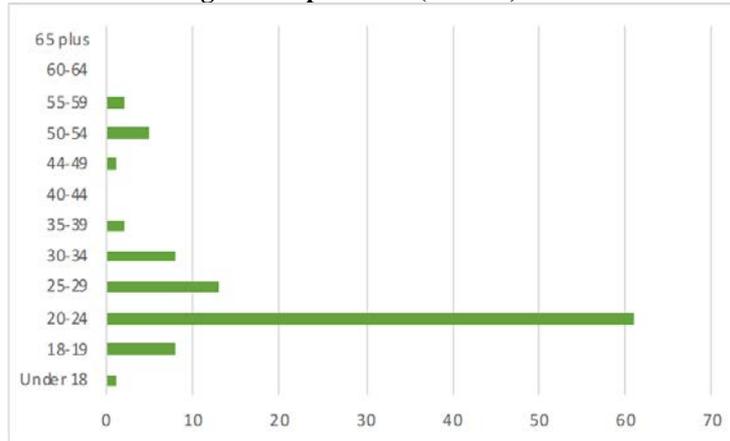
3.2. Will free Wi-Fi increase public transport use?

Of the 101 respondents, 76 stated that they do not regularly use public transport for their daily commute (at least 3 times a week) (Table 1), and it was these responses that were used to develop an understanding of how trips habits might change.

Table 1: Use of public transport for commute at least 3 times a week (based on all responses)

Regularly use Public Transport	%
Yes	24.75
No	75.25

23.68 percent of non-regular public transport users said they would increase their public transport usage if free Wi-Fi were to be introduced (Table 2). However, to develop a more detailed understanding of the people that would change their travel habits, the data was grouped into current usage levels compared with the number of people that see Wi-Fi as an incentive to increase usage, shown in Table 2. Unsurprisingly, Table 1 shows that the people who do not currently use public transport at all are the least likely to change their travel habits at only 2.63 percent. However, of those people that do use public transport, regardless of how little their current usage is, the uptake of public transport usage increases with Wi-Fi significantly more (up to 21.05 percent increase by people using public transport at least once a month). In fact, we can see that of those people who use public transport the least (once a month), are the ones more inclined to increase their current usage.

**Table 2: Level of Public Transport Use by 'Non-Users' for daily commute**

Level of Usage	Responses	Wi-Fi as an Incentive	%
Not at all	25	2	2.63
Once a month	26	6	7.89
Once a fortnight	11	5	6.58
Once a week	13	5	6.58
Total	**76**	**18**	**23.68**

3.3. Benefits to public transport users

For the implementation of a free Wi-Fi network on public transport to work, it is important people are connecting to the network while in transit. Therefore, this section aims to address two areas within the data. Firstly, it aims to address whether people will connect to the network if it is introduced and users' willingness to connect with potential 'restrictions' that might be imposed. Secondly, this sub-section aims to analyse how internet usage might change with the introduction of free Wi-Fi to help determine its usefulness for the user.

To determine if free Wi-Fi would be used while in transit respondents who used public transport at least once a month were asked about their hypothetical connection behaviours, which gave a total of 78 responses for this section. Responses were then grouped by the amount of time spent in transit for each trip to see if there was a relationship between length of journey and what people would do to connect. The results of this are shown in Figure 3 below.

Figure 3: Percentage of respondents that would connect free Wi-Fi with various 'restrictions' imposed by time travelled
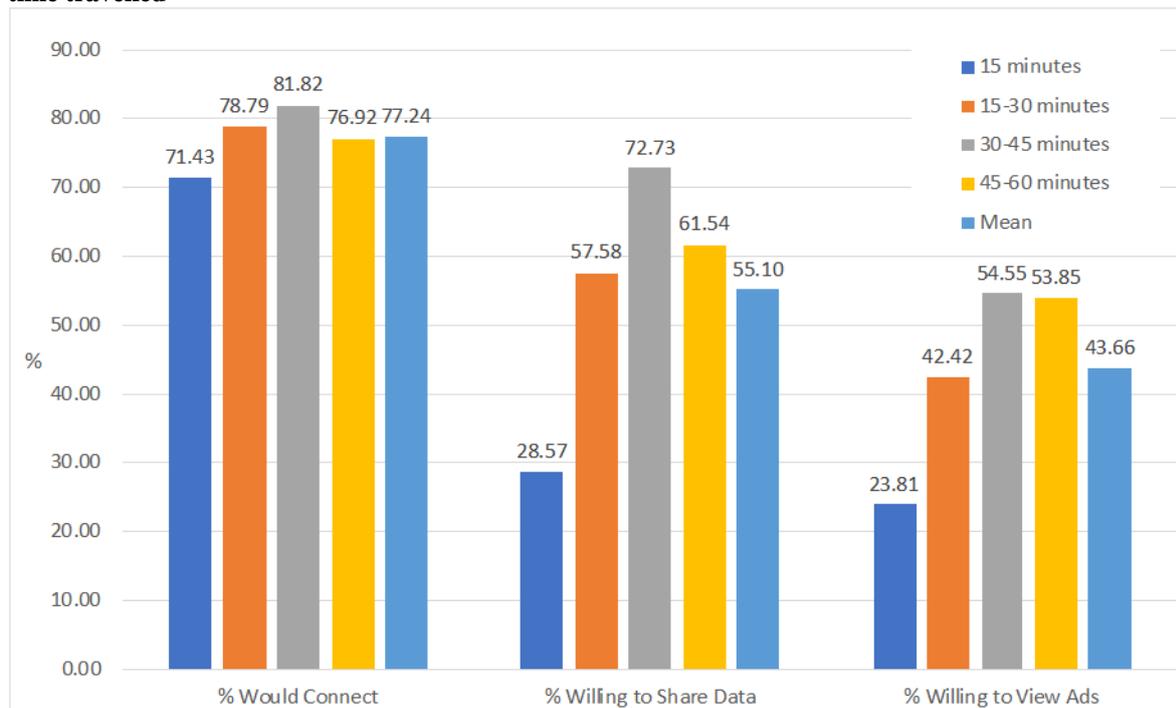

In analysing the data presented in Figure 3, there are three main points that need to be considered. The first of these is that of the 78 people that use public transport at least once a month, 76.92 percent of them said they would connect to Wi-Fi if it were to be provided completely free. Furthermore, we can also see that there is some variation in connection level with trip time, with higher connection levels associated with trips of between 30 and 45 minute duration.

The second point to consider from Figure 3 is the impact that imposing requirements on connection has on peoples' willingness to connect. Respondents were asked whether or not they would still connect to the Wi-Fi network if they had to provide personal data to connect, as well as if they were willing to view ads while connected to the network. As such, both instances of putting a requirement in place saw a drop-in willingness to connect from the initial response. Finally, the data shows that while people are less likely to connect to the network when it is no longer completely 'free', there is a relationship between those who will

connect and the time they spend in transit. Most notably, Figure 3 shows that people who are in transit for 15 minutes or less are the least likely to connect to free Wi-Fi if a login is required, or if ads are displayed. In contrast to this, people who spend more time in transit are more willing to accept these requirements with only a 9 percent drop in rate of connection when asked to log in with personal data for those traveling between 30 and 45 minutes, and 23 percent drop when asked to view ads for those travelling between 45 and 60 minutes. While more detailed targeted surveys would be necessary to understand the exact drivers of these trends, preliminary analysis would suggest that spending more time in transit creates a greater need for free access to the internet.

The need for greater internet access while travelling further can also be explained by the change in the way people use the internet with the introduction of free Wi-Fi. Figure 4 below compares current internet usage while in transit with expected internet usage on public transport should free Wi-Fi be introduced. Mostly, the changes in internet usage are relatively insignificant (about 1 percent), however, there is one shift worth noting. Figure 4 shows a decrease in general social media browsing by 6.21 percent, while streaming video content increased by 5.34 percent. What this shows is a shift from relatively low data-intensive internet usage in social media, to high-intensity data usage in video streaming. With the people who are travelling greater distances expected to use the Wi-Fi more this hypothetical change in internet usage patterns could be explained simply by people spending longer in transit wanting to pass the time with video content. As such, should free internet be introduced it will be necessary to determine whether usage in this way will be possible, and if not, how this might affect overall usage of the network.

Figure 4: Current internet usage on public transport vs expected usage with the introduction of free Wi-Fi. Social media as the dominant usage in both scenarios.
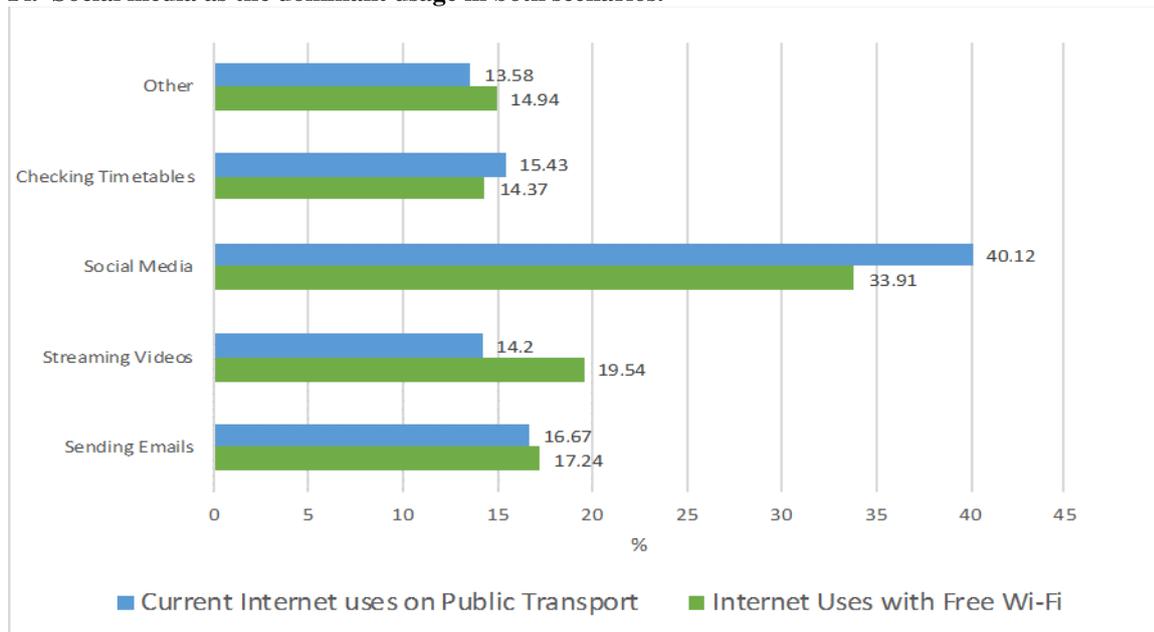

3.4 4G versus Wi-Fi

To assess the viability of free Wi-Fi on public transport it is also important to identify technologies that can limit the effectiveness of the strategy. Through preliminary readings, 4G mobile data technology was highlighted as the main technology that would compete with Wi-Fi. Therefore, to assess the effects of 4G respondents were asked about their use of the technology, with two important points in the data. Firstly, respondents were asked if they

currently have a 4G mobile data plan, with 100 percent of responses replying with yes. Secondly, respondents were asked whether the data plans that they have provides them with sufficient access to the internet while in transit. Figure 5 shows the results where 85.9 percent of respondents said that the mobile data plan they currently have provided them with sufficient access to the internet. On its own, this response could suggest that free Wi-Fi is not necessary as over 85 percent of people are happy with their current connection to the internet while in transit. However, Figure 5 also shows that 46.15 percent of respondents said that providing free Wi-Fi would change their internet usage if it were to be provided. This coupled with the 76.92 percent of people that said they would connect to the network if it was provided suggest that a free Wi-Fi network could be useful to public transport users.

Figure 5: Use of mobile data technology
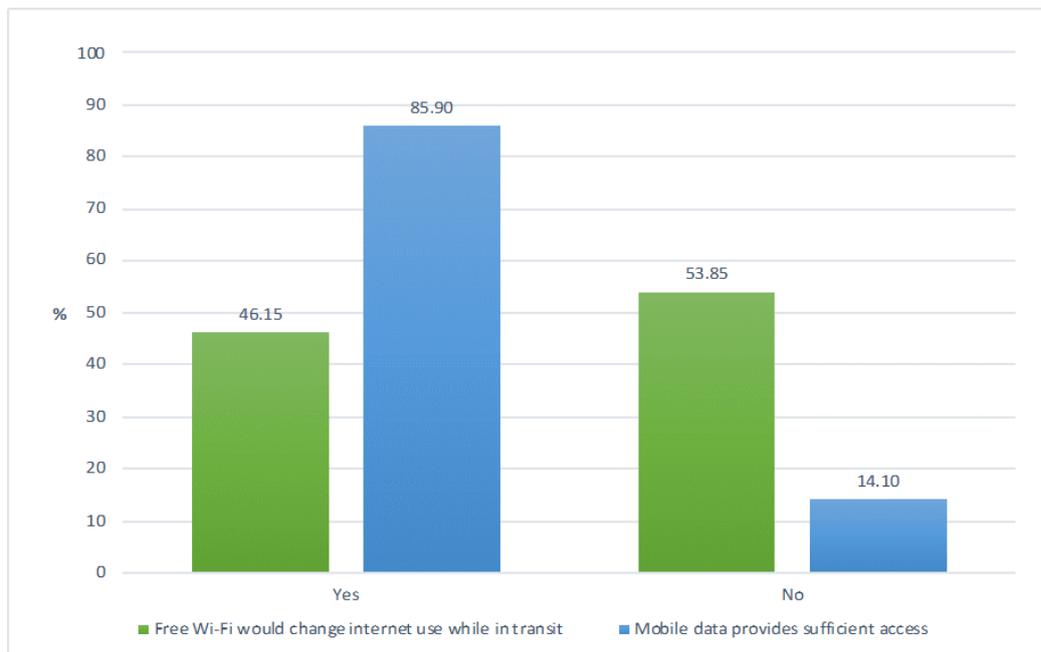
4. Discussion and conclusion

The ability to connect to the internet wherever you are has very quickly become an expectation in recent years. In static spaces this has become the norm, whether you're at home, the office, or in a hotel, Wi-Fi technologies have been an effective way to provide consistent connection to the internet. Access to the internet while in transit is the next area that expectations on connection availability have been placed. However, to be able to provide internet to the masses while in transit it is important to identify what benefit it will actually provide, accounting for context constraints. Therefore, the research described in this paper addressed what the potential benefits of providing free Wi-Fi on public transport in Perth are, particularly in the case of Millennials.

First, it is clear that the introduction of free Wi-Fi does have the capacity to increase public transport usage, with almost 24 percent of "non-user" respondents indicating they would increase their rate of public transport usage having the potential create a significant increase in the number of trips. This supports the findings of positive impacts previously reported (Banerjee & Kanafani 2008; Twichell et al. 2008; Hartwich & Buckingham 2009; Fischer et al. 2011; Rudnenko & Dauby; 2014 Dong et al. 2015; Rashedi et al. 2017). However, in saying this, with 45 percent of respondents saying the reason they don't use public transport being because it is too slow, perhaps strategies that reduce travel/wait times would be more beneficial. This aligns with the results of the mode choice modelling undertaken by Zheng et

al. (2016) which found that station, in-vehicle and destination access time as well as crowding and fares were significant factors in mode choice for both train and bus whereas free wireless access increased the utility of neither train nor bus travel.

Second, the data shows that if free Wi-Fi were to be introduced public transport users would connect, particularly in the case of trips longer than 15 minutes, a finding not previously discovered in the literature. This is important as people connecting to the network is what makes it viable. However, consistent with the findings of Axtell et al. (2008), we can also see that travelers are more reluctant to connect to the network when context constraints are present such as requiring the sharing of personal details or viewing ads. Further, our study has found that the shorter the trip (less than 15 minutes), the greater the effect of the constraint. This effect also seems to be the case of trip frequency. Dong et al. (2015) found that the fewer the trips made per week, the less the impact. Therefore, while the ability to collect user data and show ads on the network is part of the benefit to the service provider, it is important that this is done sparingly as to not discourage users.

Third, as the literature suggested, the data shows 4G mobile data technology is a significant competitor to the success of a free Wi-Fi network. While free Wi-Fi might look to be an effective strategy now, as mobile data technology improves, the benefits of free Wi-Fi could be greatly reduced.

The main limitations of this study are the small and skewed sample size (mostly Millenials, who all have 4G access) and that the effects of free Wi-Fi are considered in isolation from other factors which influence mode choice. The findings of the present study could be advanced through further research to quantify the monetary value of benefits received from free Wi-Fi, so they could be compared to costs of provision. In addition, econometric modelling could be utilized, to forecast the effect on mode share change as has been done previously, for example, by Rachedi et al. 2017 who showed, using a combined revealed- and stated - preference forecasting model, that providing Wi-Fi on public transport would increase mode share by 1.27% and decrease the share of private car modes by 1.11%. Finally, research into the effectiveness of providing free Wi-Fi relative to other possible strategies to increase public transport mode share, incorporating trade-offs made by travelers, and adjusting for context constraints which are significant as supported here, would be beneficial in providing more rigorous evidence to support decision to provide free Wi-Fi on public transport or not. While the survey used in this study focused particularly on the travel of Millennials, broadening the analysis to include a larger sample representing all travelers, possibly designed as a pre-/post- Wi-Fi implementation study, could also be valuable.

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Appendix A

Questions

1. What is your age-group?
    a. Under 18
    b. 18-24
    c. 25-34
    d. 35-44
    e. 45-64
    f. 65+

2. Which of the following best describe your occupation?
    a. Managers
    b. Professionals
    c. Technicians and Trades
    d. Community and Personal service worker
    e. Administration
    f. Sales/Retail
    g. Machinery Operators and drivers
    h. Labourers

3. Does your workplace provide some form of commuting allowance?
    a. Yes – for public transport
    b. Yes – for parking
    c. Yes – for company car
    d. No

4. For your daily commute from and to home, do you use public transport at least 3 times a week?
    a. Yes
    b. No

Answered No to question 4
5. What is your main mode of completing your daily commute?
    a. Walk
    b. Drive
    c. Cycle
    d. Taxi/Uber

6. Why do you not use public transport?
    a. Unsafe
    b. Too slow
    c. Uncomfortable/dirty
    d. Other (Please Specify)

7. Do you have a mobile data plan?
    a. Yes
    b. No

8. Would free Wi-Fi on public transport make you more likely to use the services?
   a. Yes
   b. No

Answered Yes to Question 4

9. When using public transport, which service do you predominantly use?
   a. Bus
   b. Train
   c. Ferry

10. What would be your average trip duration on public transport for your daily commute?
    a. Less than 15 minutes
    b. 15-30 minutes
    c. 30-45 minutes
    d. 45-60 minutes
    e. Greater than 60 minutes

11. Do you have a mobile data plan?
    a. Yes
    b. No

12. Does your mobile data plan provide you with sufficient access to the internet to complete necessary tasks during travel? (**This question is only displayed if yes is selected for question 10**)
    a. Yes
    b. No

13. If Free Wi-Fi was provided on public transport, would you connect to it?
    a. Yes
    b. No

14. If a condition of use of free wifi is to access your information for improving public transport services, would you still connect?
    a. Yes
    b. No

15. If adverts were displayed, would you still connect?
    a. Yes
    b. No

16. How do you currently use internet on public transport?
    a. Sending emails
    b. Streaming video
    c. Checking social media
    d. Checking trip timetables
    e. Other (Please specify)

17. Would free Wi-Fi change your internet use on public transport?

a. Yes
b. No

18. How would you use free Wi-Fi on public transport?
    a. Sending emails
    b. Streaming video
    c. Checking social media
    d. Checking trip timetables
    e. Other (Please specify)

Everyone answers these

19. While travelling overseas, have you ever connected to public Wi-Fi?
    a. Yes
    b. No

20. Assuming you have access to a mobile data connection, how important is it for you to be able to connect to free Wi-Fi while commuting to work using public transport?
    a. Extremely important
    b. Very important
    c. Moderately important
    d. Slightly important
    e. Not at all important

21. Rank the following criteria in order of your expectations of free Wi-Fi services, with 1 being the most important, and 6 being the least.
    a. Speed
    b. Free access
    c. Easy access
    d. Reliability
    e. Coverage
    f. Security

22. If you were travelling without access to mobile data, how important would access to free public Wi-Fi on public transport be to you?
    a. Extremely important
    b. Very important
    c. Moderately important
    d. Slightly important
    e. Not at all important

23. Would free Wi-Fi improve the quality of your trip?
    a. Not at all
    b. Slightly
    c. Unsure
    d. Somewhat
    e. Significantly