The Power of Exposure

Investigating environmental influences on alcohol and tobacco consumption in the urban streetscape using Google Street View and field observation

A research report by

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Abstract

AIMS: This study was the first that we know of internationally to evaluate the use of Google Street View for data collection around alcohol and smoking in urban settings. The primary aim of the study was to investigate the presence and extent of environmental influences on alcohol consumption and cigarette smoking in central business district (CBD) and suburban streets within the Wellington region. A second aim of this study was to compare the efficacy of on-site field observation with virtual observation using Google Street View, and the final aim was to provide recommendations for interventions around tobacco and alcohol control in New Zealand.

METHODS: Six suburban streets and six streets in the Wellington CBD were selected for data collection, and 400m stretches were surveyed using a data collection tool developed for this study. Evidence of alcohol sale, alcohol-related advertising, harm reduction materials, regulatory information, visible drinking and smoking, and information on outdoor seating areas was recorded.

RESULTS: Results showed quantitative and qualitative differences in alcohol and smoking-related environmental features between CBD and suburban streets, with CBD streets appearing to be more encouraging environments for drinking and smoking than those in suburbia, with more of almost all features identified per street segment when compared to suburban streets. Compared to on-site field observations, Google Street View did not appear to be as sensitive or as accurate a tool for comprehensive collection of data on environmental influences of alcohol consumption and smoking on Wellington streetscapes. However, Google Street View did show modest utility for survey of large, static components of the built environment.

CONCLUSION: Based on the environmental influences identified, we have suggested policy changes which would decrease the visibility, acceptability and accessibility of these harmful substances. Proposed changes include increasing the presence of health promotion activity to reduce

smoking, aiming to meet the target for New Zealand to become smokefree by 2025, and to reduce the burden of alcohol-related harms across the populations. Further suggestions include having stricter regulations around the abundant alcohol-related advertising seen in streets and around venues, prohibition of smoking at venues with outdoor seating areas and a reduction in density of alcohol retailers.

Introduction

This study examines the environmental influences associated with alcohol and smoking in a number of Central Business District (CBD) and suburban streetscapes in Wellington, New Zealand.

There is mounting evidence that alcohol causes considerable health burden worldwide. Recent data showed that 3.9% of global disability-adjusted life-years (DALYs) could be attributed to harm caused by alcohol, the fifth highest global risk for burden of disease worldwide (Lim et al., 2012). In 2010, an estimated 2.7 million deaths could be attributed to alcohol use (Lim et al., 2012). Beyond the significant health burden of alcohol, significant inequities exist across society. A study assessing the economic cost attributable to alcohol use disorders found that the disease burden is strongest in deprived groups and those who are marginalised from society (Rehm et al., 2009). The latest New Zealand Health Survey showed that nearly one third of all Maori adults were hazardous drinkers and were almost two times as likely to drink at hazardous levels compared to non-Maori (Ministry of Health, 2014) . There are also inequities across age groups, with alcohol being a major contributor to death in young people due to harmful or hazardous drinking habits (Connor et al., 2005; Kypri et al., 2009; Ministry of Health, 2014).

This study examines exposure to smoking as well as alcohol. Like alcohol, cigarette smoking is a significant contributor to the global burden of disease (Öberg et al., 2011). According to 2010 data cigarette smoking was the second leading risk factor for burden of disease (Lim et al., 2012). In recent years there have been legislative changes in New Zealand to decrease the environmental influence of smoking. These include significant inhibitions on advertising and the establishment of

smoke free environments (Caswell, 2014). Studies have shown that such policies have a large impact on smoking behaviour, including an increase in cessation attempts (Calo & Krasney, 2013). There is a well established link between cigarette smoking and alcohol consumption (Ministry of Health, 2015). It has been found that individuals who consume alcohol are also likely to try smoking, with heavy smoking being strongly associated with alcohol consumption (De Leon et al., 2007). Data from the New Zealand health survey showed that cigarette smoking was the most frequently reported drug used concurrently with alcohol, with 22% of respondents who were drinkers reporting smoking cigarettes while drinking in the preceding year, equating to 614,000 drinkers (Ministry of Health, 2015). This is concerning because the use of alcohol with other drugs increases the risk of harmful effects, and in adolescence is a key risk factor for later illicit drug use (Fergusson et al., 2011; Hoek et. al, 2012).

This study is focused on environmental determinants. Environmental determinants are important because the environment that one lives and works in can facilitate or prohibit alcohol use through access, exposure, and modelling (Perry & Jessor, 1985). A 2009 systematic review concluded that there was a clear link between exposure to alcohol and subsequent consumption (Smith & Foxcroft, 2009). Exposure to alcohol occurs in multiple ways. Exposure may entail the prevalence of alcohol outlets in environments, and several studies have shown a correlation between alcohol outlet density and alcohol consumption (Campbell et al, 2009; Weitzman et al, 2003; Pasch et al, 2007). Advertising of alcohol is also a source of environmental exposure. It has been shown that alcohol advertising is a predictor of alcohol intentions in young persons, a group that is particularly at risk from harms of alcohol (Anderson et al., 2009).

In 2007 a review was conducted to assess the effectiveness of the current self-regulatory framework for alcohol advertising in New Zealand. The steering group of the review concluded significant

evidence for the link between exposure to alcohol advertising and increased alcohol consumption. They therefore felt that advertising is a significant factor in the drinking culture of New Zealand (Steering Group for the Review of the Regulation of Alcohol Advertising, 2007). As a result of this review and a number of recommendations from the Law Commission, the Sale and Supply of Alcohol Act was passed by Parliament in 2012 as a reform of the Sale of Liquor Act 1989. The Act encompassed new regulations aiming to encourage the safe sale and supply of alcohol, including making the promotion of excessive drinking and promotion targeted at minors an offence (Sale and Supply of Alcohol Act, 2012). There were also reforms in the Local Government (Alcohol Reform) Amendment Act 2012. For example, it required appropriate signage in areas where an alcohol ban is in force (Local Government Amendment Act, 2012).

While a few of the Law Commission recommendations have been implemented, alcohol consumption and the smoking of tobacco continue to be significant public health issues in New Zealand. Further research needs to be conducted examining the determinants of these substances, so that policy interventions can decrease their unnecessarily high burden on health. One important area of research is to assess people's exposure to alcohol in a number of settings, including exposure to alcohol advertising, outlets, and other cues in CBD and suburban streetscapes.

Although it has been shown that there is an association between alcohol marketing exposure and drinking behaviours, there have been a limited number of studies specifically measuring the extent of alcohol imagery and venues in the urban streetscape. In the existing literature, quantitative studies aiming to examine the impact of alcohol exposure on the streetscape have utilised standardised field observations as a method to measure alcohol cues (Kuo et al., 2003). While the methodology is common between studies, there is variation between the definitions of alcohol marketing.

In a US study which aimed to measure the effect of alcohol marketing on college students, 'alcohol environment assessments' were conducted by trained researchers. An 'alcohol environment' was defined as any area containing alcohol-selling establishments, alcohol promotions, price-specials and alcohol advertisements. To limit variation between data sets an inter-rater reliability study was undertaken as well as using multiple observers and repeated measurements (Kuo et al., 2003). Another study conducted by de Brujin et al aimed to investigate the volume of outdoor advertising in public areas, in five African countries. They counted the number of billboards, posters, flags, signs, promotional items and logos on crates of beer on field observations. They found that the countries with the stricter alcohol promotion regulations had smaller adverts that were less appealing to youth, compared to the countries with self-regulation (de Bruijn et al., 2014). Other studies such as that by Gentry et al in Boston have examined the density of alcohol promotion between neighbourhoods with varying demographics. A significant finding was that there was an association between a higher frequency of alcohol advertising and areas with a lower socioeconomic standing (Gentry et al., 2011).

There has been growing interest in using Google Street View (GSV) as a research tool to assess environmental determinants in urban and suburban streetscape. Recent studies assessing GSV have found it provided reliable observation of fixed structures such as recreational facilities, the local food environment, and general land use, and these were well within the acceptable levels of agreement for data collected through fieldwork (Badland et al, 2010; Rundle et al., 2011; Vanwolleghem et al., 2015). Some of these studies have also shown data collection through GSV reduces costs and is able to be carried out objectively and unobtrusively (Badland et al., 2010; Clarke et al., 2010). Some limitations in GSV have been found including variation in time and date of GSV image capture, and problems with sensitivity (Badland et al., 2010; Wilson et al., 2015). We

could not find any published studies which have assessed GSV for researching the presence of alcohol imagery in the urban streetscape.

This study aimed to (i) describe the presence of alcohol and smoking related environmental influences in the CBD and suburban environments. (ii) Compare the efficacy of Google Street View to field observation for the investigation of the presence and extent of these environmental influences in New Zealand streets. (iii) Provide recommendations for relevant interventions in the area of alcohol and tobacco control in New Zealand.

Methods

Street segment selection

Six suburban and six central business district (CBD) street segments in Wellington, New Zealand were selected for collecting data on alcohol and smoking related features. The NZDep Scores of small suburban areas[1] in Wellington were compared and six suburbs with scores ranging from 1 to 9 were chosen to ensure the generalisability of results (University of Otago Department of Public Health, n.d.). Google Maps was used to identify stretches of 400m in each suburb encompassing a high density of retail and food outlets. Six streets in the Wellington CBD were also selected for surveying, and 400m stretches where the shops appeared most dense were chosen. The specific boundaries of street segments were either marked by street numbers or intersections, to ensure consistency between researchers. Maps were also constructed using Google Maps to illustrate the segments to be surveyed (see Figure 1 for an example, and Appendix A for full set of maps). Each street segment was surveyed both physically and virtually by GSV.

Data collection tool

Both physical and virtual surveys were undertaken using an observation tool devised by researchers that aimed to collect data on what a typical pedestrian would be exposed to when walking down the street (see Appendix B). The tool was tested and refined during a pilot of one local street segment, using both physical and virtual methods, and criteria to define each category developed to improve inter-researcher reliability (see Appendix C). Copies of the data collection tool were supplied for each survey, and were filled in as items were identified.

[1] Each small area was constructed of one or two mesh blocks calculated from 2013 census data.

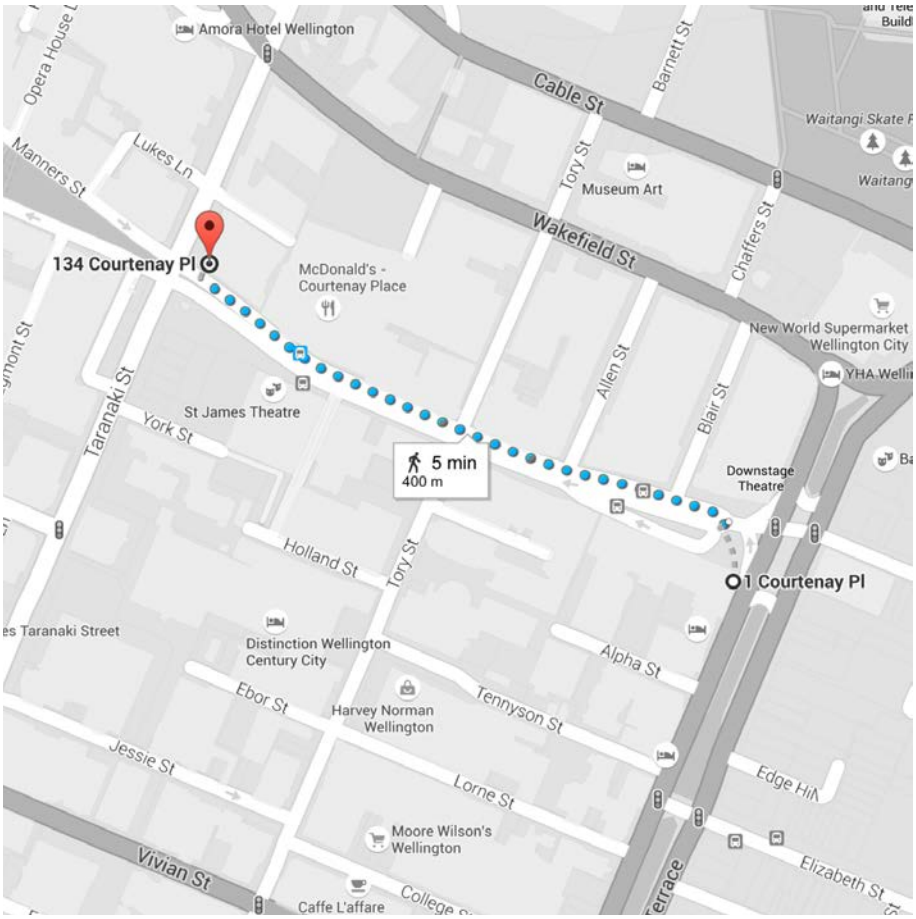

Figure 1. Example of a street segment map showing a 400m segment of Courtenay Pl, Wellington, New Zealand.

Data collection

Each survey was completed by a pair of researchers, then repeated by a second pair of researchers (for both physical and virtual surveys) to assess variability in interpretation of streetscape features. Agreement between both members of the pair had to be reached before any item was noted on the data collection tool and no pair surveyed the same streetscape twice, regardless of method used. Researchers were also blinded to other pairs' results. All surveys were done within a two week period in April 2015 (autumn in New Zealand). Ethical approval for this project was obtained in April 2015 via the standard University of Otago process for Category B approval.

Field observation

On-site field surveys were undertaken only on days with fine weather, in daylight hours, ranging from an earliest start time of 1440h to the latest finish time of 1730h. All were done on weekdays. Starting at a streetscape boundary, research pairs conducted the survey by walking down one side of the street, then back up the other, observing buildings, people, structures and signs, and noting their presence on the data collection tool. Care was taken to stop at regular intervals and look back along the street, as well as to observe structures on the opposite side of the street that could only be seen by afar (e.g. large signs high on buildings), and on traffic islands in the centre of the road. The time taken to complete the survey was noted, and Google Maps was used to calculate driving time to survey locations from a base point, excluding the effects of traffic.

Google Street View

For a given streetscape, virtual surveys were undertaken by different pairs of researchers than those that conducted the physical surveys. Virtual surveys were completed using images generated by Google Street View (GSV), using various models of Mac computers. Beginning at a boundary of the streetscape, researchers navigated down the street to the far boundary of the streetscape, then back along the other side of the street, filling in the data collection tool. If images from a footpath view were available, these could also be used to gather data. Image dates were noted regularly, and both the range of image dates in a given streetscape and the most frequent date of image capture were recorded, as well as the time taken to complete the survey. Similar to physical surveying, the angle of view was altered regularly to view entire height of buildings, to regularly look forward and back down the street to see any signs not visible from a straight-on viewing angle and to view signage in the middle of the street. The zoom tool was used to provide a closer view of signage where appropriate, taking care to always simulate the pedestrian experience.

Statistical analyses

Statistical analysis was performed to determine inter-team variability and inter-method variability. The average score intraclass correlation coefficient (ICC) was calculated to allow a measure of reliability. This was performed for two main variables: detection of venues with evidence of alcohol sale and total number of alcohol-related advertisements. ICC were interpreted with reference to common kappa coefficient cut-offs, as discussed in the literature (Norman & Streiner, 2008).

Time taken to complete data collection for each street segment was analysed with SPSS using a one-way analysis of variance (ANOVA) to compare field observation alone, field observations including travel time and GSV observation alone.

Results

In 23.3 hours of street observation by both methods, we found 317 retailers with evidence of alcohol sales and 1028 items of alcohol-related advertising across the six CBD street segments, and 86 retailers with evidence of alcohol sales and 382 items of alcohol-related advertising across the six suburban street segments. Other smoking and drinking related imagery was recorded across all 12 street segments.

I. Venues with evidence of alcohol sale

We found that over the 12 streetscapes surveyed, there were an average of eight venues with evidence of alcohol sales (hereafter referred to as ‘alcohol positive venues’) per streetscape, which varied according to location and observation method used (see Figure 2). On average, streetscapes located in the CBD had a greater number of alcohol positive venues compared to those in suburban streetscapes, with up to 44 outlets per street segment in CBD areas compared to up to a maximum of 9 in the densest suburban area (Figure 3).

The number of alcohol positive venues that were detected in the six CBD and six suburban locations using GSV were compared with those detected using field observation. Results showed that using GSV resulted in the omission of a large proportion of alcohol positive venues in the CBD. Only 43.2% of the venues identified by field observers were detected by GSV teams. However, GSV was more effective in the suburban streetscape, with 83% of the alcohol positive venues detected by field observers also being detected by GSV teams.

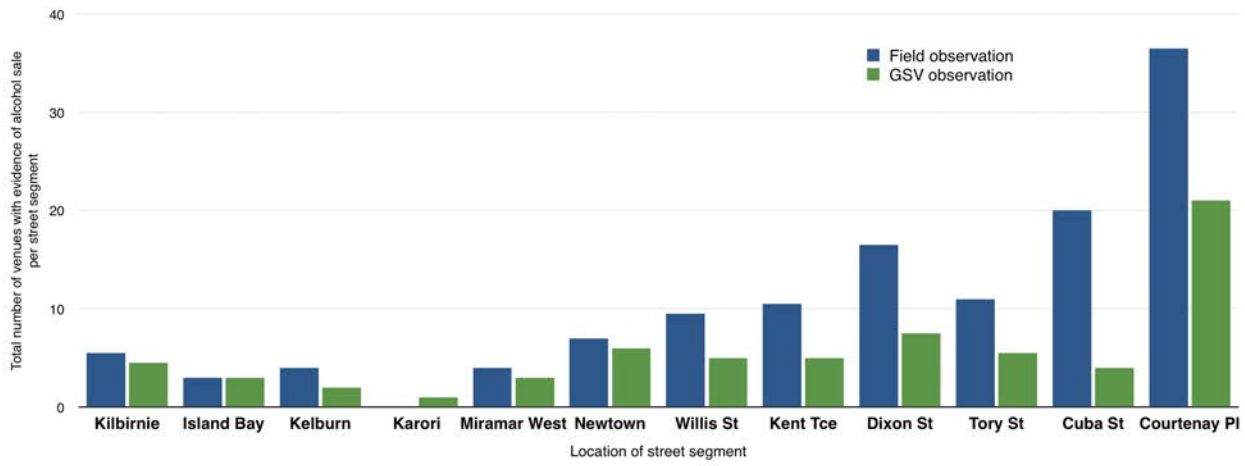

Figure 2. Total number of venues with evidence of alcohol sale in each 400m street segment location as identified by both field observation and GSV data collection methods.

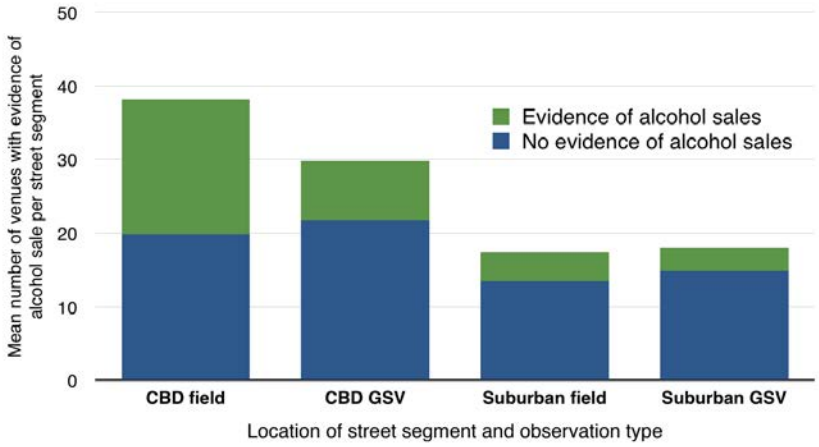

Figure 3. Mean number of venues with evidence of alcohol sale per street segment by location of street segment (CBD or suburban) and observation type (field or GSV).

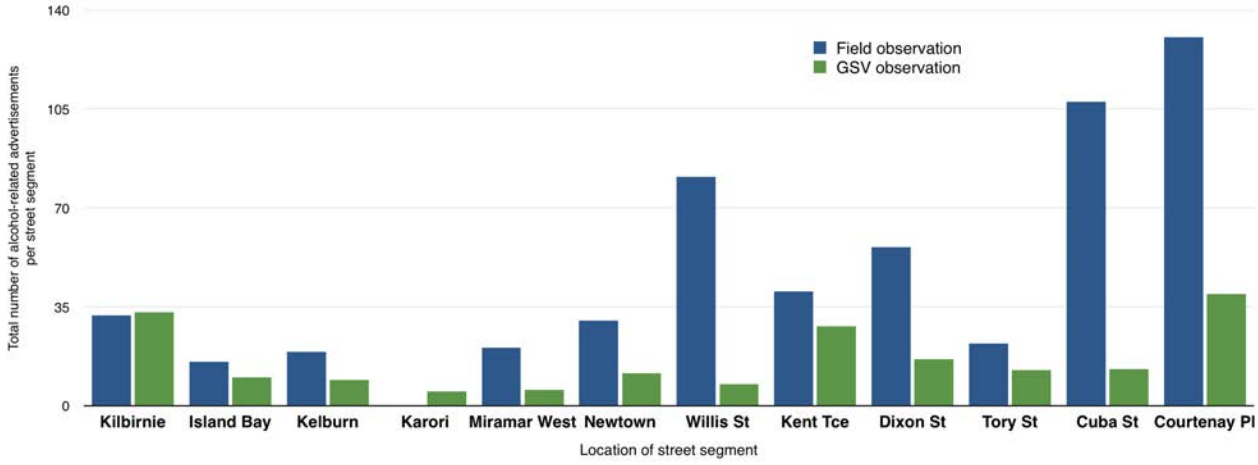

Figure 4. Total number of alcohol-related advertisements in each 400m street segment, as identified by both field observation and GSV data collection methods.

II. Alcohol-related advertising

Our results showed a mean of 43 pieces of alcohol-related advertising per 400m street segment, across the 12 streetscapes surveyed. These again varied according to location and observation method (see Figure 4). Along with fewer alcohol positive retailers, suburban streets also had less alcohol-related advertising per 400m street segment than CBD streets, with between three and 145 items per 400m street segment in the CBD compared to up to 39 items per 400m street segment found in suburban areas.

Of all alcohol-related advertising, outlet marketing[2] was the most frequently observed, followed by venue-associated alcohol marketing[3]; isolated brand marketing[4] was seen least frequently (see Figure 5). This was almost universally observed across both CBD and suburban locations, and

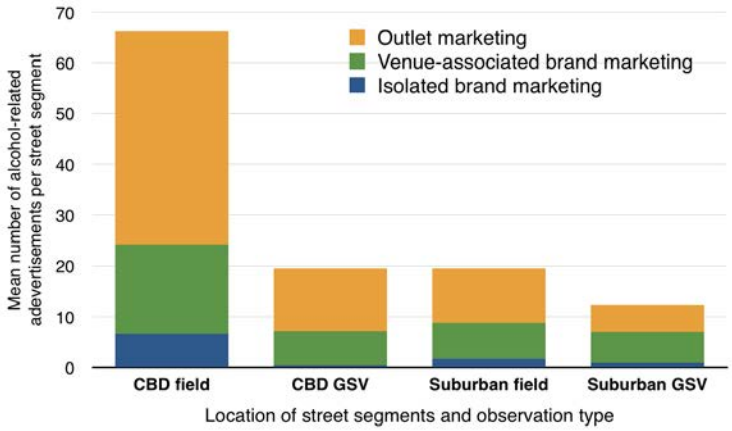

Figure 5. Mean number of alcohol-related advertisements per street segment by location of street segments (CBD or suburban) and by each method of observation (field or GSV). Also presented are the proportions of different types of alcohol-related advertisement: outlet marketing, venue-associated alcohol marketing or isolated brand marketing.

[2] Outlet marketing is anything used by a venue to encourage potential customers to visit it. Includes drink specials, 'BYO' or 'licensed' signs, display of liquor license, but not branded advertising.

[3] Venue-associated alcohol marketing is the display of logos or advertisements of specific brands by venues.

[4] Isolated brand marketing is display of logos or advertisements of specific brands in areas not associated with venues, e.g. sponsorship on promotional posters.

across both observation types, with the exception of the GSV observations in suburban streetscapes where venue-associated branded advertising was observed at very similar levels to outlet marketing.

Overall, GSV was less effective at detecting all types of alcohol-related advertising than field observation, picking up 29% of the amount of total alcohol-related advertising detected in field observation in the CBD, and around 63% of the amount detected by field observers in suburban areas.

III. Health promotion activity related to smoking and alcohol consumption

There was a marked lack of visible alcohol harm reduction and smokefree items in all streetscapes surveyed, with a mean of 1.3 alcohol-related items seen for every three streetscapes surveyed, and one smoking-related item seen for every five streets surveyed (see Figures 6 & 7). More health promotion items were observed in the CBD compared to suburban streets by field survey, however this was not replicated in GSV surveys. GSV was generally poor for detection of these materials, picking up less of both types in all areas.

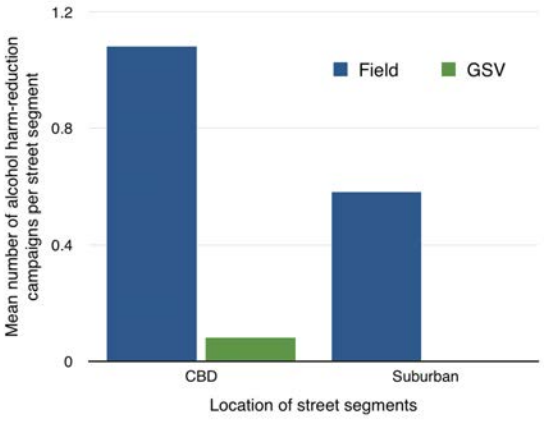

Figure 6. Mean number of alcohol harm-reduction items per street segment identified by location of street segment (CBD or suburban) for both methods of observation (field or GSV).

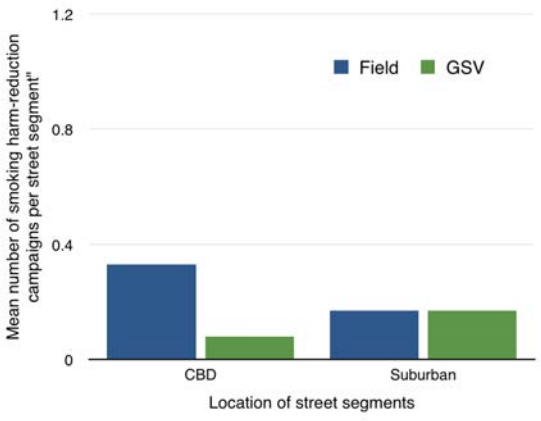

Figure 7. Mean number of smokefree items per street segment identified by location of street segment (CBD or suburban) for both methods of observation (field or GSV).

IV. Alcohol and tobacco regulation

We found that only a mean of 3.0 alcohol regulatory items and 2.4 smoking regulatory items per streetscape surveyed (Figures 8 & 9). GSV was able to identify 17% of the alcohol regulation items seen in CBD streetscapes by field observers, and 75% of that seen in suburban areas by field observers. For smoking regulatory items, none were detected by GSV in the CBD, and only 6% of the number detected by field observers in suburban streets were detected by GSV.

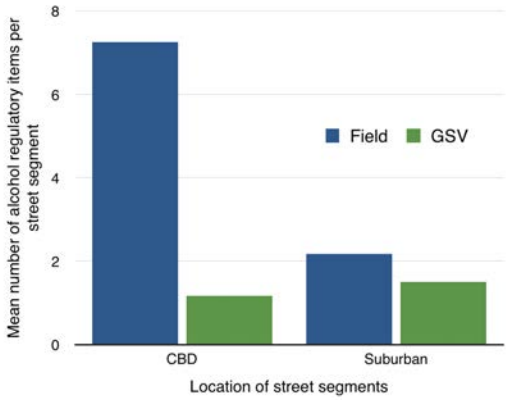

Figure 8. Mean number of alcohol regulatory items per street segment by location of street segment (CBD or suburban) and by each method of observation (field or GSV).

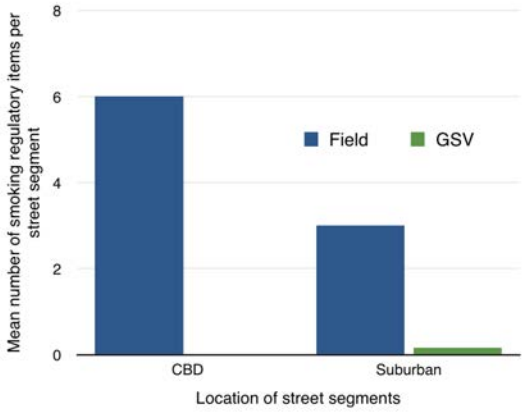

Figure 9. Mean number of tobacco smoking regulatory items per street segment by location of street segment (CBD or suburban) and by each method of observation (field or GSV).

V. Visible alcohol consumption and cigarette smoking

Our data showed that on average, approximately five people consuming alcohol and five people smoking cigarettes were seen for every two streets surveyed (see Figures 10 & 11). CBD streetscapes had the highest number of visible smokers and drinkers per street segment (up to 18 and 39, respectively), compared to up to eight visible smokers and no visible drinkers per suburban streetscape. GSV was consistently poor at identifying visible drinkers and smokers, compared to field observations.

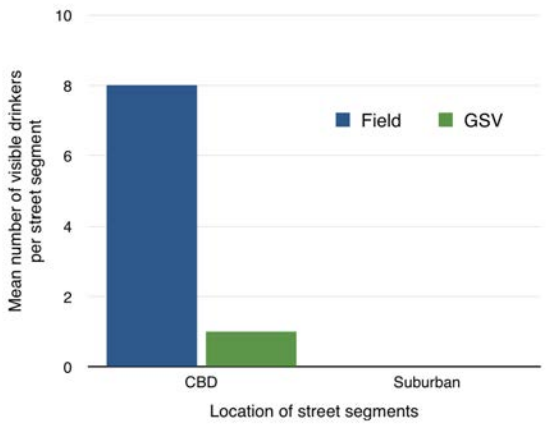

Figure 10. Mean number of visible smokers per street segment by location of street segment (CBD or suburban) and observation type (field or GSV).

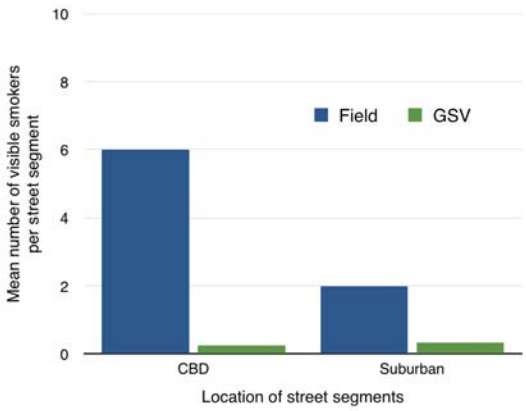

Figure 11. Mean number of visible drinkers per street segment by location of street segment (CBD or suburban) and observation type (field or GSV).

VI. Outdoor seating areas

Our results showed that each streetscape had a mean of 4.6 venues with outdoor seating areas visible from the street (outdoor areas with at least chairs, and usually chairs and tables), with CBD areas having more visible outdoor seating areas per streetscape (range: 2–22) than suburban (range: 0–7; see Figure 12). Most of these were open[5] rather than partly enclosed[6] (89% of suburban outdoors seating areas were open, 75% of CBD outdoor areas). There was little variation between GSV and field observation when observing number of outdoor seating areas in suburban streets. However in the CBD, more outdoor seating venues were found by field observation than by GSV. More *open* outdoor areas were identiied when using GSV compared to field view, but fewer partly-enclosed areas were detected (24% of those identified by field observers).

[5] Open areas were defined as areas alongside a wall, or alongside a wall with an awning, for example in front of a cafe on the sidewalk or in a garden area behind a venue.

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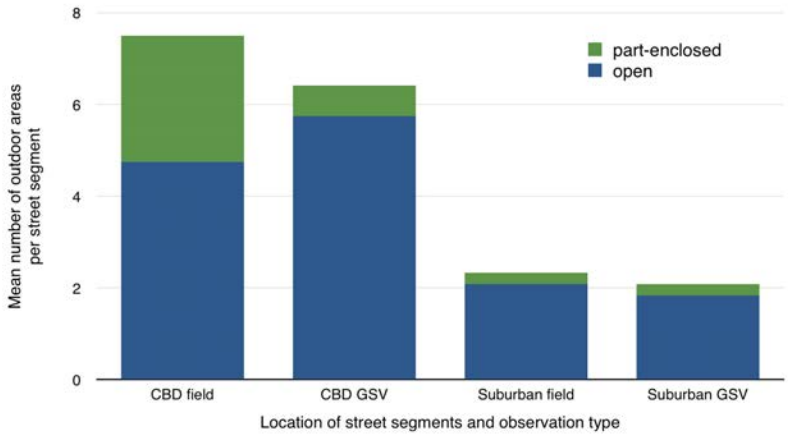

Figure 12. Average number of outdoor seating areas per street segment, by location of street segment (CBD or suburban) and observation method (field or GSV). Also shown is the proportion of outdoor seating areas that were open and part-enclosed.

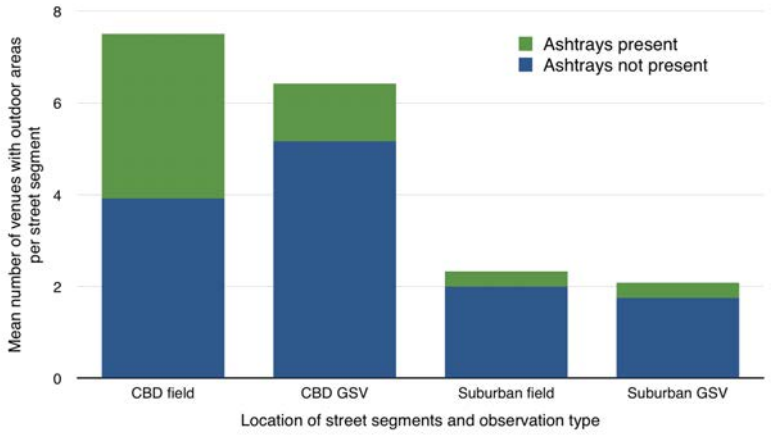

Figure 13. Mean number of venues with outdoor seating areas per street segment, by location of street segment (CBD or suburban) and observation method (field or GSV). Also shown is the proportion of outdoor seating areas that had ashtrays present, and those that did not.

VII. Ashtrays on outdoor tables

We found that approximately 1.4 venues with ashtrays were visible per street segment on average, with more visible in CBD areas (range: 0-13) than suburban areas (range: 0-2; see Figure 13). In suburban streetscapes, the same amount of ashtrays were identified using both GSV and field

observation. However, in CBD streetscapes, GSV only picked up 34.9% of the amount of ashtrays that were identified using field observation.

VIII. Alcohol consumption: encouragement vs. regulation and harm reduction

Environmental features that encourage alcohol consumption (alcohol-related advertising, hereafter referred to as 'pro-alcohol items') were compared with those that promote safe drinking or prohibit drinking altogether (alcohol harm reduction materials and regulatory signs, hereafter referred to as 'anti-alcohol items'). We found that pro-alcohol items were much more frequent in streetscapes compared to anti-alcohol items, with a mean of 29.4 and 3.5 per streetscape, respectively, see Figure 14. The CBD had more pro-alcohol items than suburban streetscapes (42.8 per street segment, compared to 15.9 per street segment in suburban), as well as more anti-alcohol items (4.8 per street segment in CBD, compared to 2.1 per street segment in suburban), although in both areas the frequency of anti-alcohol items was low.

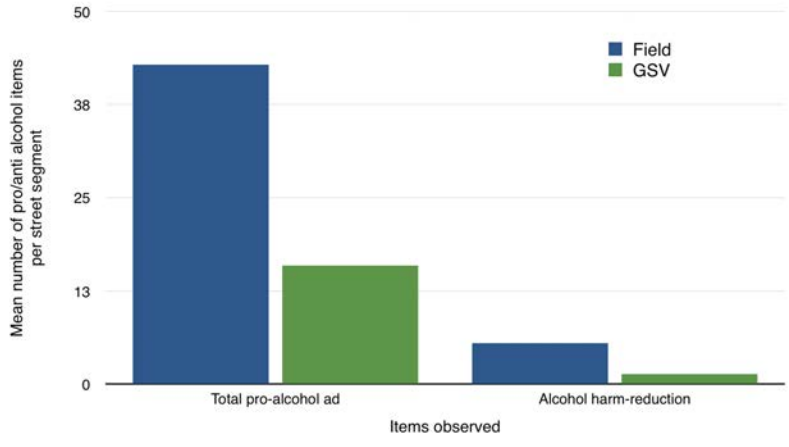

Figure 14. Average number of pro and anti-alcohol items per street segment, by observation type (field or GSV). 'Pro-alcohol' includes all alcohol-related advertising, and 'anti-alcohol' includes both alcohol harm-reduction materials and regulatory signs.

In the CBD, GSV was poorer than field observation at identifying both pro- and anti-alcohol items, picking up 29% of the number of pro-alcohol items than field observers did, and 15% of anti-alcohol items that field observers found. This trend was also observed in suburban streetscapes, with GSV picking up 63% of the number of pro-alcohol items that field observers identified, and 55% of anti-alcohol items as field observers.

IX. Time taken to survey

The time taken to complete field observation and GSV observation was analysed across all street segments (see Table 1.). Field observation was performed in a mean of 32 minutes (range: 22–72 min), which increased to 39 minutes when including travel time (range: 17-83 min), while GSV surveying was completed in a mean of 29 minutes (range: 15–41 min). There were no statistically significant differences between field observation time, field observation including travel time and GSV observation time as determined by a one-way ANOVA ($F(2,64) = 2.43$, $p=0.096$).

Table 1. Range, median and mean time taken (minutes) to complete data collection by field observation with and without travel time, and GSV observation.

	Field	Field including travel time	GSV
Time taken (minutes)			
range	11–75	17–83	9–47
median	26	33	29
mean	32	39	29

Note. Travel time was calculated using Google Maps, excluding traffic effects.

Table 2. Range and dominant image collection dates for streetscape segments surveyed using Google Street View, by location.

Location		Range	Dominant
CBD	**Cuba St**	Aug 2008 –Feb 2015	February 2015
	Courtney Pl	Aug 2008–Feb 2015	February 2015
	Tory St	March 2011–Feb 2015	February 2015
	Dixon St	Dec 2011–Feb 2015	February 2015
	Willis St	Aug 2008–Feb 2015	February 2015
	Kent Tce	Oct 2013–Feb 2015	February 2015
	Newtown	Feb 2011–Feb 2015	February 2015
Suburban	**Kilbirnie**	Oct 2009–Feb 2015	February 2015
	Kelburn	Dec 2010–Feb 2015	February 2015
	Karori	Nov 2010–Oct 2013	October 2013
	Island Bay	Aug 2008–Feb 2015	February 2015
	Miramar	Aug 2008–Feb 2015	October 2013
All		**Aug 2008 – Feb 2015**	

Note. Dominant date for each street segment judged by observer pairs during surveying based on most common image date.

X. Inter-observer and inter-method variability testing

Both inter-observer variability (between pairs surveying the same street segment) and inter-method variability (between field observation and GSV observation) was calculated to investigate whether there was variability in the number of venues with evidence of alcohol sale and the number of alcohol-related advertisements, two key items of data gathered across all the streetscapes surveyed.

A high degree of reliability was found between pairs of field observers in detection of venues with evidence of alcohol sale. The average measure intraclass correlation coefficient (ICC) was 0.933 with a 95% confidence interval ranging from 0.778 to 0.980 ($F(11,12)= 14.9$, $p<.001$; see Figure 15). Similarly, a high degree of reliability was found between pairs of GSV observers in detection of the same class of venues, with an ICC calculated as 0.848 with a 95% confidence interval from 0.494 to 0.956 ($F(11,12)= 14.9$, $p<0.001$; see Figure 16).

A similar analysis was performed for the detection of alcohol-related advertisements. A high degree of reliability was found between pairs of field observers in the detection of alcohol-related advertising, with an ICC calculated as 0.922, with a 95% confidence interval ranging between 0.724 and 0.979 ($F(11,12)= 12.8$, $p<0.001$; see Figure 17). In contrast, only a moderate degree of reliability was seen between pairs of GSV observers in detection of the same class of items. The average measure ICC was 0.595, with a 95% confidence interval from –0.346 to 0.882 ($F(11,12)= 2.47$, $p=0.07$; see Figure 18).

Inter-method variability revealed a poor to moderate degree of reliability between field and GSV observation. A moderate degree of reliability was seen between field and GSV observation in detection of venues with evidence of alcohol sale, with an ICC calculated as 0.503, with a 95% confidence ranging from –0.046 to 0.824 ($F(11,12)= 3.03$, $p=0.03$; see Figure 19). The same analysis performed for alcohol-related advertising suggested poor reliability between field and GSV observation, with an ICC of 0.039 with a 95% confidence interval from –0.53 to 0.597 ($F(11,12)= 1.08$, $p=0.45$; see Figure 20).

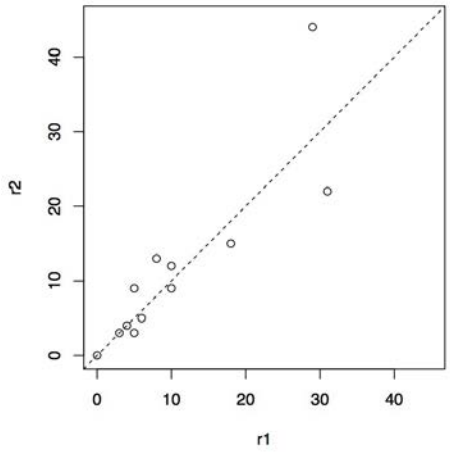

Figure 15. Variability between pairs in detection of venues with evidence of alcohol sale during field observation.

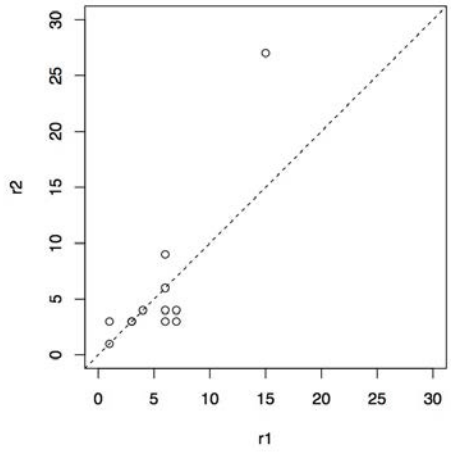

Figure 16. Variability between pairs in detection of venues with evidence of alcohol sale during Google Street View observation.

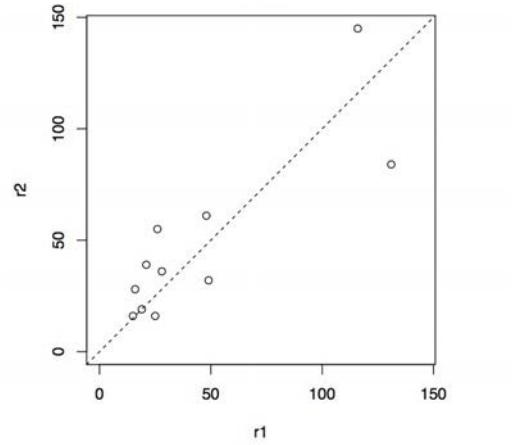

Figure 17. Variability between pairs in detection of all alcohol-related advertisements during field observation.

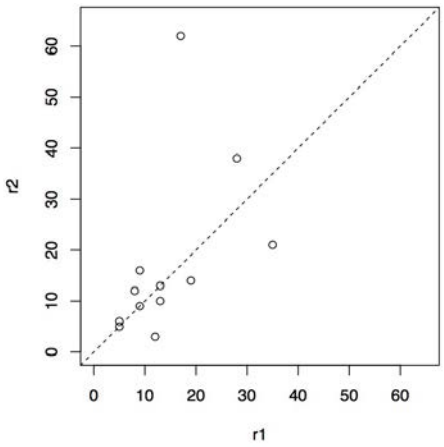

Figure 18. Variability between pairs in detection of all alcohol-related advertisements during Google Street View observation.

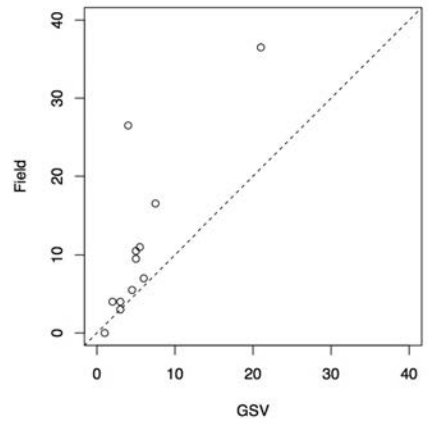

Figure 19. Variability in observation method in detection of venues with evidence of alcohol sale, field observation vs Google Street View.

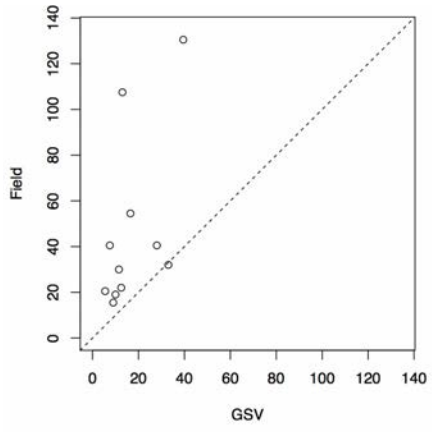

Figure 20. Variability in observation method in detection of all alcohol-related advertisements, field observation vs Google Street View.

Discussion

Main findings and interpretation

Our research revealed a number of important findings regarding the extent of health determinants in the surveyed Wellington streetscapes. A number of key influences on alcohol consumption, including retailers with evidence of alcohol sale, alcohol-related advertising, outdoor hospitality seating areas and visible drinkers were all identified as factors present in suburban and CBD streetscapes.

Street segments located in the CBD had both a greater total number of retail outlets and an increased proportion with evidence of alcohol sale (i.e. density) when compared to suburban areas. This is in line with previous research conducted in Manukau, New Zealand, reporting that more on-licence outlets are present in town centres (Alcohol Advisory Council of New Zealand, 2012).

Hospitality venues with outdoor seating areas were also identified through our survey as they have recently been an area of policy interest in New Zealand. This was following a High Court decision that the methods used at that stage to calculate whether an area can be classified as ‘outdoor’ and therefore can allow smoking was not appropriate (Paul Badco, 2015). This interest follows on from research that in some ‘semi-enclosed’ outdoor areas the air quality was still poor enough to exceed WHO air quality standards (Edwards & Wilson, 2011). The court decision has prompted a review of how outdoor areas are defined (Ministry of Health, 2015). This is particularly relevant to our study, as people may be more likely to smoke at a venue if there is a designated outdoor area. Smoking in these outdoor areas means that staff and patrons may be exposed to increased amounts of

carcinogenic smoke. The presence of outdoor seating areas at venues was noted across both the CBD and suburban streetscape, but at least twice the number of outdoor seating areas were detected per CBD street segment compared to suburban segments. Our data also revealed that the vast majority of the areas detected were classified as “open” i.e. one wall and a roof or less, with relatively few “part-enclosed” areas detected.

Our results also showed that at the time of data collection (i.e. mid to late weekday afternoons) people could be seen smoking cigarettes and drinking alcohol on the streets, with an average (across all the street segments) of five people seen smoking and five seen drinking alcohol for every two streets surveyed. The CBD environment had by far the higher number of smokers and drinkers per street segment (up to 18 smokers per street segment and 39 drinkers per street segment) compared to suburban streets (in which at most, eight visible smokers were seen per street and no visible drinkers were seen in any street). GSV proved a poor tool for investigating visible smokers and drinkers, possibly because image capture of stationary and moving people tends to be of poor resolution, where it may be difficult to see if someone is holding an alcoholic drink or cigarette. Our findings support the conclusion that there was a high visibility of alcohol advertising, outlets and other cues in the CBD streetscapes which may normalise and perpetuate alcohol and tobacco consumption in New Zealand. The same conclusions cannot be made for suburban streets.

Health promotion and regulation

Although the harms of alcohol and smoking are well documented (Lim et al, 2012), our results revealed a remarkable scarcity of visible harm reduction material for alcohol, or smokefree messaging. Health promotion items (previously called counter-advertising in our data collection tool) is a category encompassing public health activity, e.g. safe-drinking billboards, and non-

legislated signage promoting safe behaviours, e.g. safe drinking host responsibility statements, such as those seen on windows of on-licensed establishments (see Figure 21). This material was not prominent in either CBD or suburban streetscapes,

regardless of method of observation. In contrast, alcohol regulatory signage – which included both legislated signage and displayed licenses (see Figure 22 for an example) – had a more notable presence in the streetscape. Though even when harm reduction materials and regulatory signage was combined as 'anti-alcohol' signage, this was still vastly outnumbered by pro-alcohol advertising (29.4 pro-alcohol and 3.5 anti-alcohol items per streetscape on average). This seems to suggest that while retailers have a willingness to encourage use of alcohol via alcohol-related advertising, they appear to be reluctant to disclose the negative effects of alcohol. The obvious financial benefit of retailers to maximise revenue by encouraging alcohol and tobacco consumption clearly seems to outweigh a more ethical approach of maximising the wellbeing of their patrons. One way this could be achieved is by more alcohol harm reduction activity by retailers (e.g. safe drinking guidelines in bars, host responsibility statements that make it clear taxis are available).

Figure 21. Host responsibility statement seen on a venue, an example of a harm reduction item.

Viability of GSV observations

Our results clearly suggest that the use of Google Street View is not yet able to match field observation in the detection of the visible determinants of alcohol and tobacco consumption in New Zealand's streetscapes. Field observation almost universally revealed far more data of all kinds

when compared to GSV. This leads us to believe that while GSV may offer some advantages, field observation remains the more sensitive tool and is a better indicator of the pedestrian experience. The sensitivity difference between GSV and field was most apparent when examining venues with evidence of alcohol sale and alcohol-related advertising. The detection of visible smokers and drinkers in the streetscape was a source of significant variation, with GSV proving vastly less sensitive. This may be due to the small size of cigarettes and alcoholic beverages which are difficult to identify in often poor quality images with limited zoom. GSV observation yielded less data of all types, and while using this method showed trends towards taking a shorter amount of time to collect data, in this particular study the difference compared to field observation was non-significant. However, it is plausible that further familiarisation with the technique could enable a significant reduction in time taken to survey compared to surveying on foot.

GSV's in-built blurring algorithms, which are used to maintain anonymity of people photographed, also limit detection when items are close to the face, as is often the case with smoking and drinking. GSV also performs automatic blurring of a large proportion of signs, likely intended to blur vehicle license plates. This can render detection and categorisation of some signage difficult. The range in the date and time of GSV image capture may account for some of observed variation, when compared with field observation. Though the majority of imaging was relatively current – being taken within the last 6 months – the

Figure 22. Examples of alcohol regulatory signage.

approximate interval between image capture in urban NZ is on the order of 3–5 years, which poses challenges for the future use of the method. Current imaging would be a necessity for usage of GSV to monitor compliance with policy, which may remain impossible unless image capture becomes more frequent. The timing of GSV images was variable, with the major limitation due to its restriction to daylight hours. While day-time capture only was consistent with our field measures, future study in this area should consider the data that is likely to be missed by exclusion of night-time observation. GSV's method of imaging was further limited by the inaccessibility of GSV camera to parts of certain streets, which often resulted in suboptimal image angle or quality.

Inter-method reliability testing of both venues and total alcohol advertising detected suggested a poor to moderate concordance between field observation and GSV. This analysis supported the subjective experience of observers: small item detection was difficult using GSV, though large static objects proved relatively simple.

From the results of our study, we conclude that similar studies may still depend on fieldwork to ensure a reliable and accurate reflection of the streetscape. However, GSV may provide useful data on large, static components of the built environment (e.g. venues and large signs). Though statistical analysis revealed a non-significant difference in the time taken to survey the standard street segments, the use of GSV trended towards a shorter survey duration. This may become more pronounced with increased familiarity with the technique of data collection using GSV. Finally, a key advantage of GSV remains its potential to be used to collect data across a wide geographical area in whole country or even multi-country studies.

Strengths and weaknesses of the study

Strengths

This study took a novel approach for collecting data on alcohol and smoking cues in urban settings by utilising GSV alongside traditional field observation. Another strength of this study include its sampling of a wide range of streets in Wellington City region – both in the CBD and suburbia. By using a number of CBD and suburban areas across a range of NZDep scores, we were able to achieve a fairly broad sample of Wellington City retail streets that should provide at least some degree of generalisability for Wellington suburban and urban shopping streets as a whole, and possibly to the retail areas of other large New Zealand cities.

For each street segment data were collected from two field and two GSV observations, each by different pairs of observers to minimise biases in data gathering. These two measurements allowed calculation of a mean value per street segment and the production of more accurate results. All pairs never repeated measurements on the same stretch of road in either field or GSV observations, which aimed to minimise any potential learning or familiarity effects. Blinding also occurred between pairs, with no data shared until all collecting in those areas was completed.

Rather than having single observers, we used pairs to decrease variation. Data recorded needed to be agreed on by both assessors with reference to the standardised checklist, leading to discussions and logical agreement on how to classify items. To aid this we generated a series of guidelines which outlined examples of how to classify and deal with items that we were unsure on, further decreasing variation and increasing reproducibility of the results.

The study aimed to reproduce the experience of a person walking down a street. Observer instructions were designed so that items were only recorded if they were likely to be seen by a

“reasonable pedestrian” and the assessor attempted to walk down footpaths in the way the average pedestrian would. This enabled us to have a reasonable degree of confidence that the data we gathered was meaningful for informing policy and intervention implications.

Weaknesses

Our study was ethically approved for data collection during daylight hours only. The fact that GSV images were also taken during daylight hours makes it broadly comparable to the field observation, but exclusive use of daylight data may limit our ability to draw universally applicable conclusions. Previous research has demonstrated that smoking in the Wellington CBD is more visible in the evening when compared to midday (Chan et al., 2014; Martin et al., 2013). As our data was collected between these time points, we suspect that our findings may not reflect the maximal amount of exposure, and hence the maximum potential to influence behaviours, that may occur during the evening.

To locate stretches of street for investigation, Google Maps was used to plot courses and find suitable distances. However, Google Maps universally rounds distances to the nearest 50m, resulting in our final ability to standardise street length being limited to 400±50m. Variations in the lengths of street segments may have contributed to some of the variation in gathered data.

By gathering data using eight pairs performing observation by both GSV and field survey, we were able to maximise data collection and mitigate observer biases. However, the use of a larger number observers ultimately may have led to an increased inter-observer variation. ICC values generally supported a high degree of reliability between pairs for observations of venues, but this reliability was diminished in our analysis of alcohol advertising detection. The study design was intended to

minimise this by use of the standardised checklist and guidelines and the establishment of agreement between two assessors. However, inter-observer variation, though not optimal, is likely to be impossible to eliminate, in part due to personal differences in how human researchers observe and respond to behavioural influences in the streetscape. It is conceivable that variability between observers could be mitigated by more rigorous training, though this may have had limited benefit in the data-rich CBD.

Both methods of observation require a basic knowledge of local signage practices and common brands to enable accurate data gathering. Due to the observers being almost exclusively New Zealand raised and 20–30 years of age, our knowledge of alcoholic brand names, common signage and advertising practices was generally sufficient. However, this may not always be the case and should be an important consideration for future research attempting to use similar methods. Prior knowledge was especially critical in GSV, as signs were often blurry, unclear or of poor resolution. The requirement of background knowledge may severely limit GSV's applicability in international or cross-cultural contexts.

Research implications

At this stage, we do not recommend the use of GSV for the comprehensive study of the influences on smoking and alcohol consumption in New Zealand's streets. At present its flaws in image quality, frequency and consistency are too great an impediment to complete reliable data collection. However, GSV may have significant merit for the surveying of large, static components of the built environment (e.g. venues and large signs). Furthermore, we recognise that other countries and areas may have better image quality and more recent data, and in these places GSV will be a more viable research tool. It is worth noting that "foothpath views" in GSV were occasionally available in our

study and were of a much higher image quality and yielded a more accurate representation of the pedestrian experience. If this footpath view were to become more universal in New Zealand, and image quality and frequency were increased, GSV could become be a more valid tool for surveying of alcohol and tobacco related imagery in the streetscape. However, in this setting and at the time of data collection it failed to sufficiently match the efficacy of direct field observation.

Wellington's CBD and suburban streetscapes present a wide range of cues promoting alcohol use and smoking behaviours. We suggest it would be beneficial to know the human impact of these triggers, specifically, to what degree are these triggers consciously observed by a person walking down the street? More importantly, how much of an impact do these triggers have on the behaviour of typical young people and adults? Further research may also need to place more focus on the evening streetscape, as this may be more consistent with the peak periods of smoking and drinking.

Policy implications

A number potential policy changes could be made to reduce the burden of alcohol and tobacco consumption. These all aim at reducing the visibility, acceptability and access to these harmful substances. For alcohol, there is also a need for relevant health information at outlets and venues. Given their scarcity in the surveyed Wellington streetscapes, a greater focus on the comprehensive implementation of alcohol harm minimisation and smokefree activity may be a possible intervention. These would fall in line with the current Government target for New Zealand to become smokefree by 2025, and to reduce the burden of alcohol-related harms across the population.

Regulation of alcohol related advertising would also have a significant impact on the street presence of alcohol. The amount, size and the hours of display of advertising could be targets of regulation. To reduce the amount of cigarette smoking in outdoors seating areas there could be prohibition of smoking in these areas, or as overseas, in wider areas (e.g. 10 metres from doors and windows, or all CBD pavements). To complement a 100% smokefree policy, the presence of ashtrays would also be prohibited. Another approach could be to reduce the number of venues selling alcohol. This could be done via a density approach, restricting the number of venues per unit area (Campbell, 2009). However, this would be unpopular from the perspective of retailers and may have significant financial implications for the retail sector – though the *economic* impacts to wider society could be beneficial by the reduction in alcohol-related harm. To effectively address these issues, a combined approach of both government level policy and community involvement is needed, including businesses where possible (Jones, 2014).

Ethical issues

In New Zealand, there are clear inequities and inequalities in both alcohol and tobacco use and how their harms are distributed across the population. Rates of hazardous drinking are considerably higher in Maori and as a consequence they, along with other more deprived population groups, suffer a high burden of alcohol- and tobacco-related harm. To minimise the harms caused by the ubiquity of alcohol and tobacco in our streets, various policy and community level interventions would need to be implemented, as discussed above. Any such intervention would lower both the level of use and associated harms of alcohol and tobacco across the board, but would most likely have a larger impact on those most affected and thus act to reduce inequalities.

Another ethical consideration is the effect of policy change on personal autonomy. While it could be argued that there is little autonomy with the constant bombardment of advertising and the use of alcohol and tobacco, it conversely could be argued that restricting advertising may also breach autonomy. This is a clear example of the tension between an autonomous and liberal viewpoint and a more paternalistic approach. A sliding scale exists in which we weigh up the “freedom of commercial speech” with the protection of citizens and especially those who are most vulnerable from its negative influences. From a strictly ethical viewpoint, we believe it may be better to reduce some of the autonomy of alcohol retailers in order to reduce health loss in our society.

Conclusion

This study confirmed that environmental features associated with alcohol and tobacco consumption have a significant presence in Wellington streets, particularly in the CBD, with far fewer harm reduction materials and greater amounts of alcohol-related advertising and retailers compared to suburban streets. Previous research has indicated that exposure to alcohol can influence drinking behaviours and conversely, that the establishment of smoke free environments and placement of limits on cigarette advertising has increased smoking cessation attempts. As alcohol and tobacco both cause significant health burden in New Zealand, efforts should be made to limit exposure to alcohol and tobacco in our environment, given its potential to influence behaviour. In light of our findings, our discussion has outlined potential policy and community interventions to reduce the presence of alcohol and tobacco in the street environment, including broader implementation of harm minimisation items, stricter regulation of alcohol advertising (number, size and hours of display) and prohibition of smoking cigarettes in outdoor seating areas. Both government and community commitment would be required to maximise the effectiveness of these interventions.

This study also examined the effectiveness of on-site field observation and GSV observation for research in this area, and results suggest that GSV cannot yet match field observation in sensitivity of data collection in the urban streetscape. GSV has potential utility for measuring large, static elements of the built environment but still has many limitations. As this technology develops, we anticipate these may lessen and it may prove a more valuable tool for comprehensive street surveys in the future.

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Appendix A

Street segment maps of all streets surveyed, along with NZDep ratings for the selected small areas – an index of socioeconomic deprivation, with 1 being least deprived and 10 being most deprived. The ratings used have been based on the 2013 NZ census data.

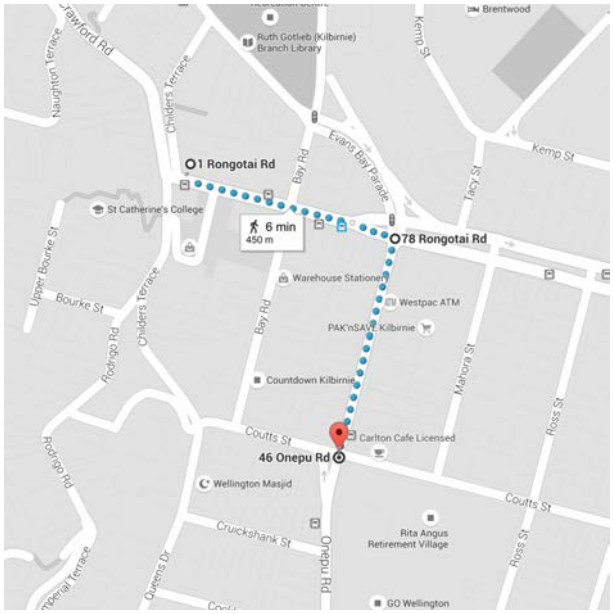

Figure A1. *Kilbirnie: 1 Rongotai Rd to corner of Coutts St and Onepu Rd; NZDep 8*

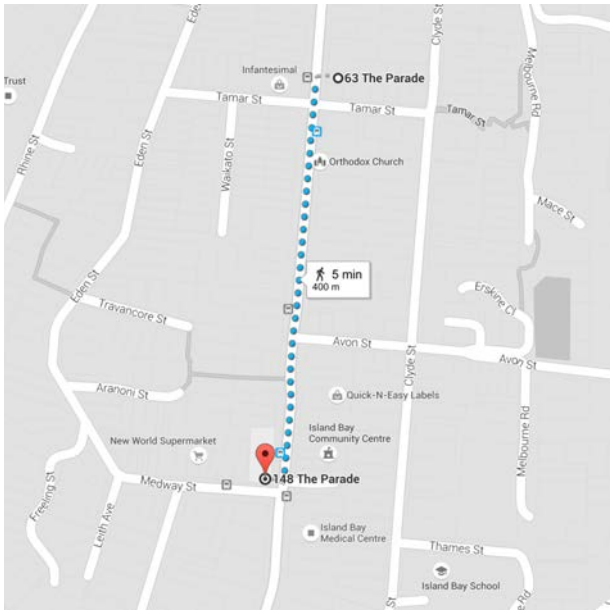

Figure A2. *Island Bay: 63-148 The Parade; NZDep 2*

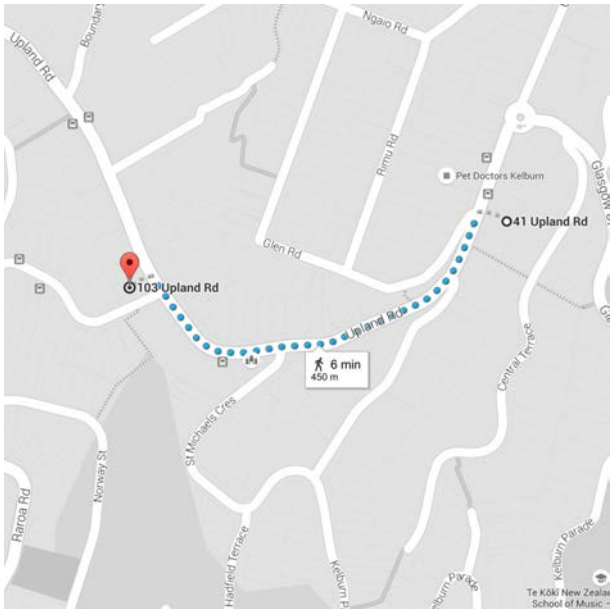

Figure A3. *Kelburn: 41-103 Upland Rd; NZDep 5*

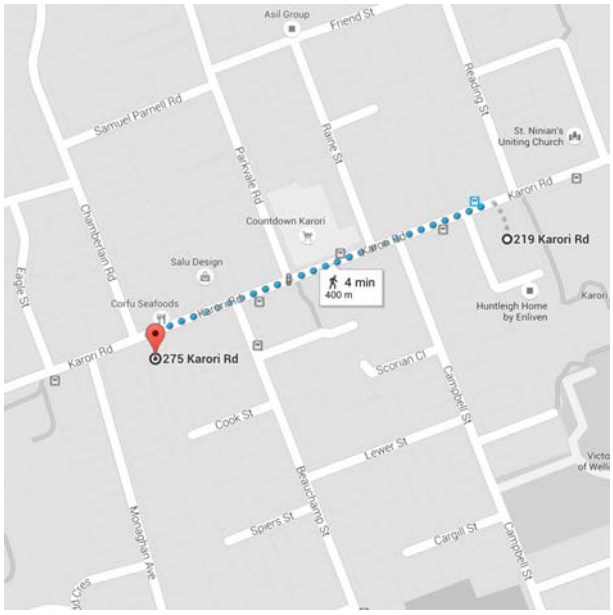

Figure A4*. Karori: 219-275 Karori Rd; NZDep 1*

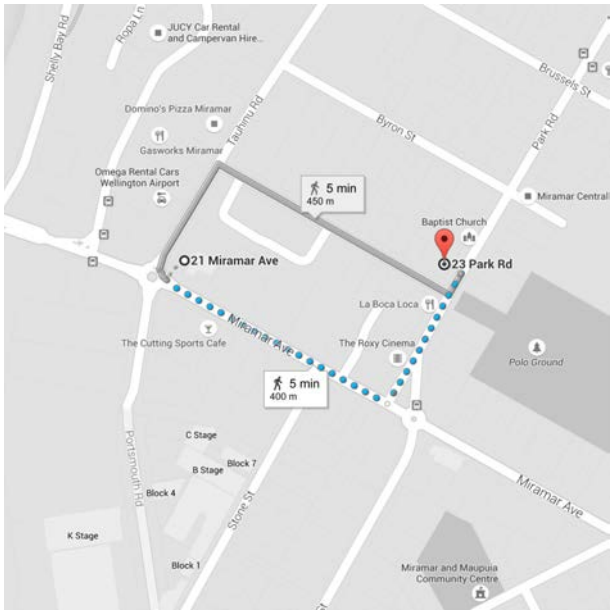

Figure A5. *Miramar West: 21 Miramar Ave to 23 Park Road; NZDep 9*

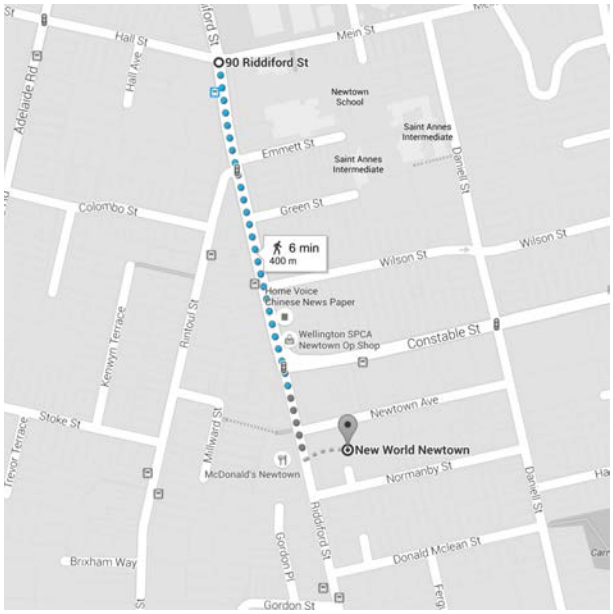

Figure A6. *Newtown: 90 Riddiford St to New World Supermarket; NZDep 7*

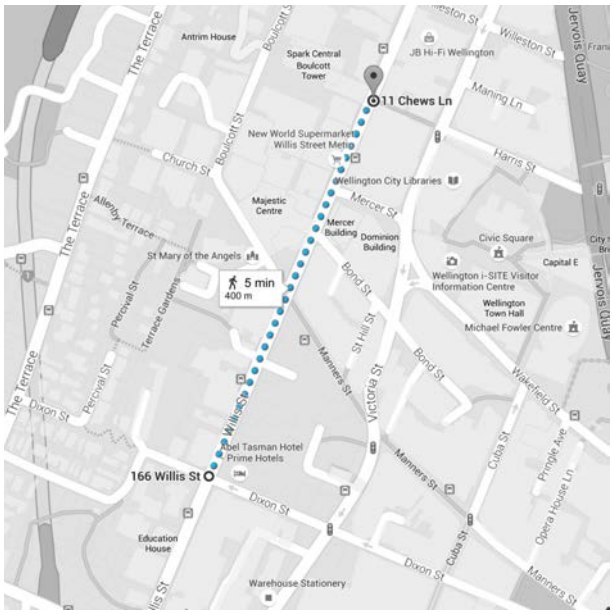

Figure A7*. Willis Street: from Dixon St intersection to Chews Lane intersection.*

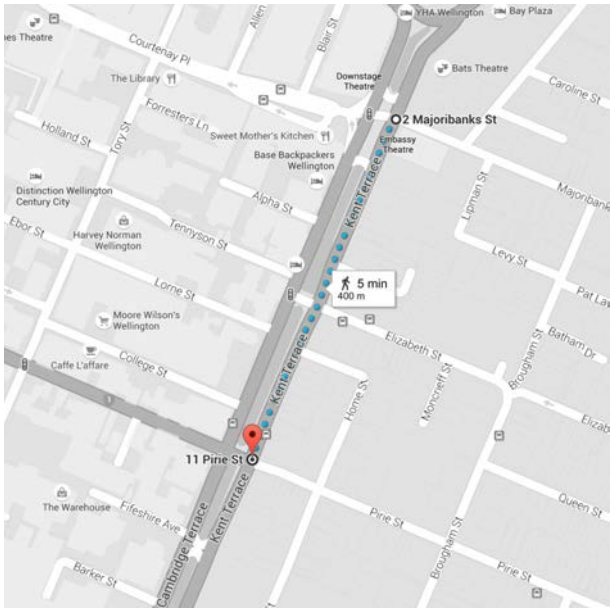

Figure A8*. Kent Terrace/Cambridge Terrace: from Courtenay Place intersection to Pirie St intersection.*

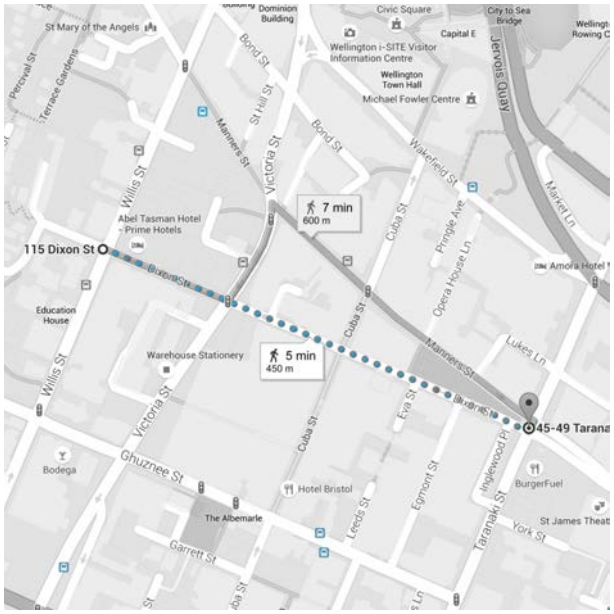

***Figure A9**. Dixon Street: from Willis St. intersection to Taranaki St. intersection.*

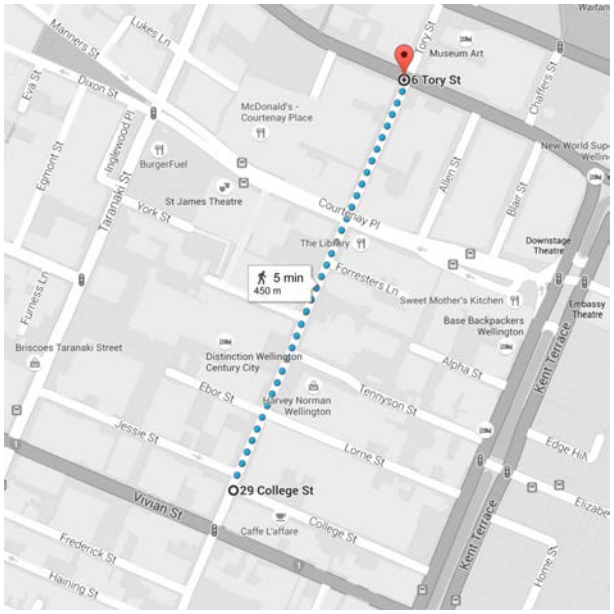

***Figure A10**. Tory Street: from College St. intersection to Wakefield St intersection*

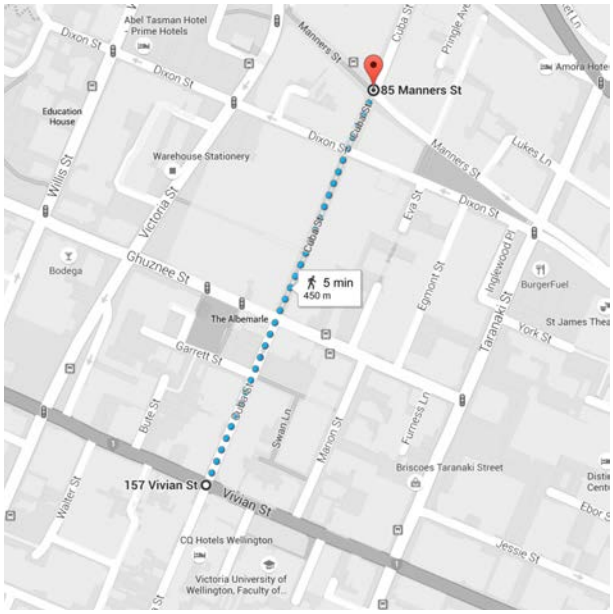

Figure A11. *Cuba Street: from Manners St. intersection to Vivian St. intersection.*

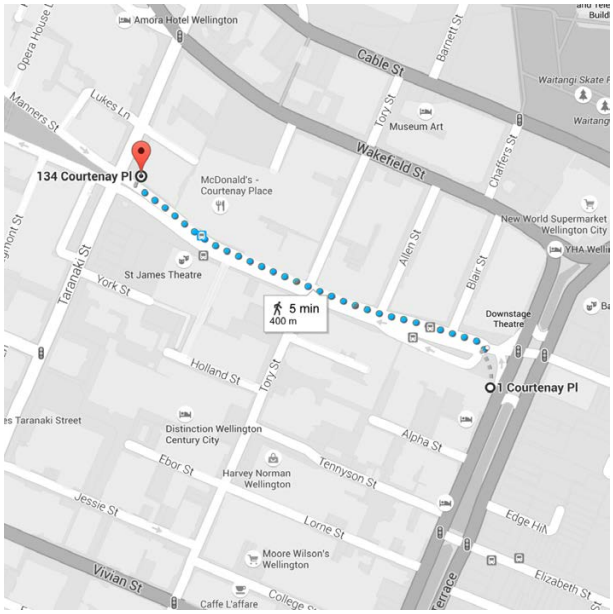

Figure A12*. Courtenay Place: 1-134.*

Appendix B

Street Survey Tool 0.6

Location			
Method (GSV or Field)		Team	
Date			
Time	Depart WSM	Arrive Site	
	Survey start	Survey finish	
	Depart Site	Arrive WSM	
Mileage/Bandwidth			
GSV date stamp	*range*	*dominant*	

Venue type	**Alcohol (–)**	**Alcohol (+)**
Food (cafe, restaurant, fast food)		
Bar		
Liquor store		
Convenience		
Supermarket		
Other		

Signage			
Advertisement	*Corporate/branded*	***isolated***	
		venue assoc.	
	Outlet marketing		
Campaign/counter-ads (anti-drinking/safe drinking)	*Alcohol related*		
	Smoking related		
Regulatory (liquor ban, smokefree etc)	*Alcohol related*		
	Smoking related		

Other		
Outdoor areas	*open*	
	part-enclosed	
Visible smoker +ve	*stationary*	
	walking	
Visible drinker +ve		
Ashtray +ve venues		
Alcohol trash (cans, bottles)		
Other*	*pro-alcohol*	
	pro-smoking	

Notes

Figure B1. *Standardised street survey tool devised for use in this study.*

Appendix C

Survey Guidelines

Main aim is to ***recreate the pedestrian experience***. Items noted must be able to be seen by a reasonable pedestrian walking down the centre of the footpath who has stopped to look around. Ensure you turn and look behind you at intervals to identify features facing the other direction, and look in the centre of the road.

Venue

- **Alcohol (–)**: no *evidence* of alcohol being sold, e.g. advertisements, visible alcohol behind counter in store seen from street. If no evidence and researcher knows this venue sells alcohol, still counted as –ve.
- **Alcohol (+)**: *evidence* of alcohol being sold or able to be consumed on the premises, e.g. specials boards or signs, alcohol-branded signs out the front (e.g. Steinlager brand printed on blackboard or wall indicating they sell Steinlager), liquor licence in window, BYO, 'licensed'.

Signage

- **Advertisements**:
  - **Corporate/branded** marketing is advertisement of alcoholic beverage brands (or similar)
    - **Isolated**: e.g. sponsorship on posters, any marketing for alcohol brands not aiming to draw people into a venue selling them.
    - **Venue-associated**: brand advertising draws people into the venue directly, usually because the venue sells *x*. (E.g. Steinlager on a blackboard (note – this could count for both corporate/branded marketing and also indicate that a venue sells alcohol so be responsible for two tallies), brands on bar windows or stools, liquor store stating drink specials for a particular brand.)
  - **Outlet marketing**: anything that is used to lure people inside, e.g. drink specials, printed signs saying BYO or LICENSED, liquor license on windows, happy hour ads, but NOT including alcohol brand marketing. Are all classed as venue associated.
- **Campaigns & counter-ads**:
  - **Anti-smoking**: e.g. bus ads
  - **Anti-drinking or safe drinking**: e.g. billboards, host responsibility statements (these are not regulatory alcohol as are not required by law, but can also be counted as an indication that alcohol can be consumed on premises)
- **Regulatory**:
  - **Alcohol**: green signs saying not to serve under 25s without ID, not to serve intoxicated people, etc.
  - **Smoking**: e.g. smokefree signs or signs with slash through cigarette
- **Outdoor areas**: must have seats to count as an outdoor area
  - **Open**: e.g. out the back of a café, in front of a café on the footpath with an overhang
  - **Part-enclosed** (more than a wall and awning/roof)
- **Visible smoker**
  - **Stationary**: e.g. people sitting on benches, standing outside venues, sitting in outside areas
  - **Moving**: e.g. people walking along the street
- **Alcohol trash**: beer bottles/beer cans/empty boxes or reasonable other

Figure C1a. *Accessory guidelines for categorisation with the standardised street survey tool devised for use in this study.*

Notes

- **Multiple signs/features**
  - If the same sign is duplicated multiple times, record this multiple times
  - For posters, if one poster is repeated in a cluster, score this once. If the same poster is located in multiple areas separately, score it every time you see it.
  - For a double-sided sign (e.g. liquor ban signs) if both sides can be seen on same street, tally twice.
- **Special cases**
  - **Gig posters**: ignore unless specifically mention alcohol (e.g. 'Sponsored by Tui' would be tallied as isolated corporate/branded)
  - **Alcohol-specific events**: e.g. hopfest – corporate/branded, isolated
  - Include ads on buses and cars that go past
- **Side streets**
  - Don't walk down side streets. If a venue on the street you are surveying also has a side on a side street, can note things associated with this that you can see from your allocated street. Nothing on side streets not associated with buildings on the main street can be notated.

Unsure? Anything recorders are unsure of should be photographed/screenshot and NOT tallied. Note down which street it was from and flag for follow up review.

***Figure C1b**. Accessory guidelines for categorisation with the standardised street survey tool devised for use in this study.*