

Why do cyclists feel safer in inner Amsterdam and Copenhagen than Melbourne? A Contextual Framework

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Abstract: Adult transport cycling in Inner Melbourne (and other Australian capital cities) has not been seen as ‘safe enough’¹ to be a mainstream transport choice since at least the 1950s. In Northern Europe however, in cities like Amsterdam and Copenhagen, significant and increasing numbers of adults use bikes for inner city transport, suggesting many feel cycling is ‘safe enough’, like walking, public transport and car use. Cities with significant levels of cycling experience a wide range of economic, social, health and environmental benefits. This paper makes a contribution to quantifying comparisons of cycling safety outcomes between similar city areas and provides a framework for exploring changes to the context in which adults make travel choices. Drawing on document analysis and key informant interviews in Melbourne, Amsterdam and Copenhagen it suggests that a comprehensive approach is needed, including attention to: land use planning, design philosophy, education and national policy, as well as infrastructure, to improve outcomes and perceptions about the relative safety of cycling.

Introduction

My research interest in cycling comes from decades working in transport planning, mostly in Melbourne (Australia). In 2010 a friend told me about a young professional woman who, after being encouraged to cycle to work in the city by a neighbor, had been run over by a truck. The young woman survived but sustained horrific injuries. I was deeply disturbed by this story and thought ‘this is not good enough, surely city cycling could be made safer’. In Amsterdam and Copenhagen for example, one sees many more adult cyclists, including many women, on upright bikes and in ordinary clothes, as shown in Figure 1. I wondered, could cycling in Inner Melbourne² be made safe enough?



Amsterdam



Copenhagen



Melbourne

Figure 1: Cycling in Amsterdam, Copenhagen and Melbourne

¹ The idea of a ‘safe enough’ environment for cycling draws on Winnicott’s concept of ‘good enough’ parenting, i.e. providing an environment that is not perfect but good enough and with scope and agency to make adaptations for success. Winnicott, D.W., 1954. Mind and its Relation to the Psyche-soma. *British Journal of Medical Psychology*, 27, 201-209.

² For comparisons with inner Amsterdam and inner Copenhagen I use the inner area of Melbourne (Inner Melbourne), as defined by the municipalities of Maribyrnong, Melbourne, Port Philip, Stonnington and Yarra, known as the IMAP area and the Plan Melbourne Central Subregion. The IMAP municipalities are part of 19th century Melbourne, much of the area is relatively flat and was developed in the pre-car era. I am thus excluding Melbourne’s middle and outer car centric suburbs for the purpose of my comparisons.

Background

Lack of safety was identified by Bauman et al as the major deterrent to more transport cycling in Australia, (2008). Dutch cycling expert Godefrooij (in Agudo, 2014) says safety is the pre-condition for cycling. Increasing road trauma to cyclists in Australian cities and perceptions about the risk of sharing roads with heavy traffic, appears to deter significant numbers from transport cycling (Pattinson and Whitzman, 2013) (Lindsay, 2013, Nieuwesteeg, 2013). Garrard et al (2010) note that in Melbourne, with an increase in cycling from 2000, there was a doubling of deaths and serious injuries over eight years (Garrard *et al.*, 2010). Garrard also notes that for adults who own bikes there has been an increase in the risk of potential injury from bike use relative to car use. Data from the Victorian Transport Accident Commission also shows a 43% increase in claims from cyclists in the Inner Melbourne area for the four years to 2011 (Nieuwesteeg, 2013). A survey for VicRoads (the State of Victoria's main road authority) found that because of traffic safety concerns, cycling to convenient destinations in the inner area was not considered an option by most (81%) bike owners (Hall and Partners, 2010). The Melbourne experience stands in strong contrast to that of Copenhagen where, between 2000 and 2011, there has been an increase in cycling and a significant decline in the numbers killed and injured (City of Copenhagen, 2013).

In this paper I argue that, with attention to differences in contexts, lessons can be learnt from Amsterdam and Copenhagen. Each case study city has a long history of cycling and the cities are reasonably comparable although Inner Melbourne has some hills, and a milder climate (Pattinson and Whitzman, 2013). A bike is the fastest means of travel for short trips by adults in each city but is little used in Melbourne.

In travel behavior modeling it is recognized that choice of mode is strongly influenced by (subjective) perceptions about each mode (Stern and Richardson, 2005). Mode share is an outcome of travelers' perceptions about speed, cost and safety of available modes. Fear and feeling vulnerable has a powerful influence on travel choices (Goodwin, 2008). The fundamental importance that people place on safety was identified last century by psychologist Maslow (1943) in his Hierarchy of Basic Needs. Maslow argued that after we have satisfied the need for shelter and food, we organize our lives for safety and in doing this we rely on the familiar. Stern et al also found that while comparative travel safety did not explicitly figure in day-to-day mode choice, people would only consider modes perceived to be safe. Cycling safety thus cannot be considered in isolation of the safety provided by other modes. People's perceptions of safety are a complex construct influenced by multiple factors including their experience and the views of others. 'Norms Theory' (Vandenbergh, 2003), maintains that people avoid activities that would be seen to violate social norms, such as a belief (in Australia) that cycling is dangerous, and that people also feel the need to influence family and friends to avoid activities that are not normal or dangerous, like transport cycling.

For my approach I also draw on Winnicott's (1954) psychological insight that an environment need not be perfect, but does need to be 'good enough' to allow people agency to make adaptations that can lead to satisfactory (safe) outcomes. That is, travellers need a safe enough environment to consider using a mode and to perceive that they have the agency to make a safe trip, e.g. travelling at a safe speed in a safe vehicle.

Cyclists are very vulnerable and risk consequences, beyond those reported in road trauma statistics, which include sprains, abrasions, damage to clothing and trip delay. Potential transport cyclists need assurance, in advance of choosing to ride, that the risk of a crash or fall has and can be minimized. Such an assurance requires attention to what Haddon (1972) called the pre-crash phase, and ideally what the Japanese high speed rail industry call 'Crash Avoidance' (Suyama, 2014). By way of contrast, a measure like helmet wearing, is only relevant should a crash occur, to reduce the likelihood of brain injuries. Avoidance of situations that could lead to a crash or fall are taken as the priority for potential cyclists. Improving perceived safety for potential cyclists therefore requires more than a reduction in the number of reported deaths and serious injuries, as targeted by road safety campaigns such as Towards Zero, (State Government of Victoria, 2015).

Method

To explore the contexts for different perceptions between the three inner cities I use the qualitative-interpretive research methods described by Schwartz-Shea and Yanow (2012). Interpretive methods may include objective data, open-ended interviews and observation, acknowledging that meaning is

local, context related and constructed by individual actors. In 2012 I made preliminary visits to informants in Melbourne, Amsterdam and Copenhagen. Then in 2013 and 2014 I conducted over 30 face to face interviews and observations in: Melbourne (20), Amsterdam (4 plus 2 by Skype and email) and Copenhagen (7). Informants were selected because of their involvement in transport cycling with Governments, as representatives of interest groups or as academic researchers. Reports and guidelines from these cities were also identified and reviewed. My understandings were verified by my observation and reflections as a cyclist, pedestrian and public transport user in each city and by emailing summaries and follow up questions to my informants. While all informants were fluent in English, one of my challenges in northern Europe was to recognise nuance and understand local constructs that appeared to be familiar, but were different. An example was the different meaning and intent of 'road hierarchy' in the Netherlands, where the hierarchical function of and speed limit applicable to any road or street can usually be discerned from the way cyclists are treated (Scheepers *et al.*, 2014).

I work from the premise that adults will only use travel modes that they perceive to be safe for their particular trip, and that such perceptions are made (constructed) in a broad context. A 'safe enough' context thus needs to be provided such that together with individual actions, like riding slowly and choosing protected routes, a high level of safety can be co-created. First I develop a means of comparing transport safety outcomes in the case study cities that considers road trauma (fatalities and serious injury) relative to mode use. Then, using interviews, document analysis and observations, I identify and explore what appeared to be key measures for a safe context that are under-developed or missing in Inner Melbourne.

Findings

Data obtained from the Victorian Government survey of travel (VISTA, 2012-13) for trips to and within the Inner (IMAP) area of Melbourne, shows that cycling was used for less than 5% of trips, compared to more than 28% of trips in Amsterdam and Copenhagen, as shown in Table 1. In Inner Melbourne cycling would be the cheapest and quickest mode for many short trips. That greater use is made of motor vehicles, public transport and walking suggests that safety is a significant factor underlying travel choices in Inner Melbourne.

Table 1. Mode Share (percentages of trips)

	Inner Melb. (VISTA 2012-13)	Amsterdam (Fietsberaad 2010)	Copenhagen (C of Cph. 2015)
Mode:			
Priv. Motor Vehicles	46.6	27.	33.
Public Transport	21.2	18.	20.
Walk	26.6	24.	17.
Cycle	4.7	28.	30.

For Inner Melbourne, by comparing mode share (VISTA 2012-13) with road users killed and seriously injured (CrashStats) it can be seen that cyclists experience disproportionate trauma with 4.7% of trips experienced 23% of road trauma (Figure 1 below).

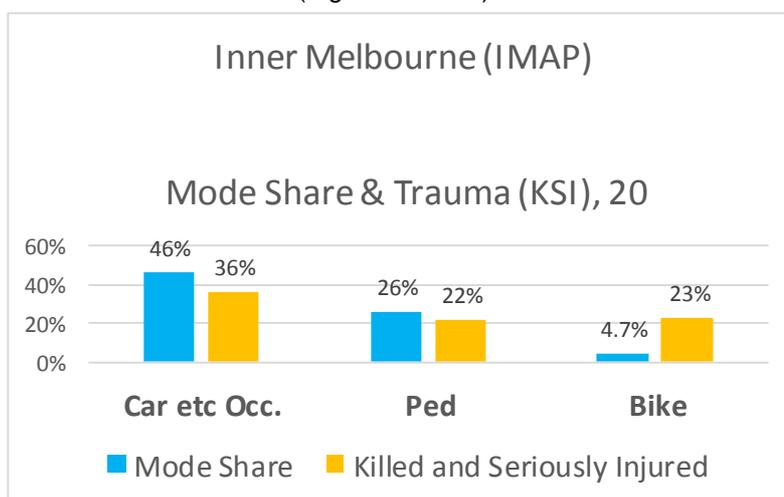


Figure 1 - Mode Share and Road Trauma, Inner Melbourne

Epidemiological comparisons between cities are usually based on population size and do not take account of travel exposure (W H O, 2013). To express comparative cyclist safety between cities I developed a cyclist trip risk index, 'F' for the risk of fatalities, and "S" for the risk of serious injury (Table 2). The index allows for the effects of population size and mode share:

Cyclist Fatality risk index (F) = Cyclists killed per 100,000 population divided by cycling's mode share (M).

Cyclist Serious Injury risk index (S) = Cyclists injured per 100,000 population divided by mode share (M).

The formula shows cyclist risk reducing as cyclist mode share increases, and/or the rate of cyclist deaths and/or injuries reduce. Percentage mode use is seen as the key exposure factor as this reflects the comparative efficiency of the land use and transport arrangements in each city, rather than travel distance or time on the road. That is, the trip is considered of prime importance, not its length.

The index shows that for cycling trips in Inner Melbourne the risk of death is lower than for the whole of Metropolitan Melbourne (2.8 compared to 4.7), but marginally higher than in Amsterdam or Copenhagen. For serious injuries in Inner Melbourne however, the SI risk index is much greater (744 compared to 468 for the whole of Melbourne) and more than 3 times higher than in Amsterdam.

Table 2. Cyclist Trip Risk

Urban Area	Metro Melb	Inner Melb.	Amsterdam	Copenhagen
Population (100,000)	40.87	4.46	8.20	5.59
Cycling mode share (M)	<2%	4.7%	28%	30%
Fatals/yr. (yrly avg)	3.8	0.6	5.9	4
<i>Fatalities rate per 100,000</i>	0.09	0.13	0.72	0.72
<i>Fatality trip risk index (F)</i>	4.7	2.8	2.6	2.4
(Recorded) Serious Injuries (SI)	363	156	<i>130+390*</i>	n/a
<i>SI rate per 100,000</i>	0.09	0.35	0.63	
<i>SI trip risk index (S)</i>	468	744	226	
<i>Serious Injury/Fatality ratio</i>	95	260	88	

Sources: Melbourne, CrashStats 2009-2013; City of Amsterdam and SWOV 2014; City of Copenhagen, 2014)

*In Amsterdam, 130 involved motor vehicles and 390 did not involve motor vehicles.

As shown in Table 2, deaths to cyclists are only the tip of the road trauma iceberg, with a ratio of recorded serious injury numbers to road deaths of 260/1 (in Inner Melbourne). Deaths are thus not a good indicator of the perceived risk of cycling. The Serious Injury risk index for Inner Melbourne, at 744, is 67% higher than the index for metro Melbourne overall and more than 3 times that for Amsterdam. As a reference point, using this methodology, the Car trip injury index for vehicle occupants in Inner Melbourne is 126, which is almost 1/6th that of cycling. The injury risk index thus appears to support perceptions of the participants in a survey for VicRoads (Hall and Partners, 2011) noted above, on the risks of riding in Inner Melbourne.

There are several issues with the reliability, comparability and conclusions that can be drawn from statistics on fatalities and injuries. In each inner area the number of fatalities are accurately collected but are very small. In Amsterdam particularly and Copenhagen to a lesser extent, the fatality numbers may overstate comparative danger due to low levels of helmet wearing. It has been estimated that perhaps a third of the fatalities in Amsterdam could have been avoided if helmets had been worn at levels as in Melbourne (Institute for Road Safety Research (S W O V), 2012a). Road injury numbers are, in contrast, inconsistently collected and under reported, with as few as 10% of cyclists injuries being recorded in some jurisdictions (Janstrup *et al.*, 2014). It is to be noted records on road trauma do not differentiate between recreational and transport cyclists. There are also significant differences in causes, particularly for cyclists, between fatalities and injuries. Fatalities tend to be caused by isolated extreme behavior, while the much larger number of injury crashes typically have system errors as the main (97%) contributing factor (Wundersitz and Baldock, 2011). SWOV and others thus argue that new and different policies and measures, that focus on system improvements, are needed to reduce road injuries, compared to the regulatory and enforcement focus that has contributed to reductions in fatal injuries.

Perceptions of Safety: A Contextual Framework

In the City of Copenhagen there has been an explicit emphasis on measuring and increasing the percentage of cyclist that feel safe, so as to increase the amount of cycling (City of Copenhagen, 2012). With a focus on perception and as a development of Schepers et al's (2013) ideas about perceptions of cycling safety relative to other modes, I developed a framework, the EPV context model, to illustrate the clusters of system factors likely to influence perceptions. The factors were identified from interviews, document analysis and observations, as explained above. The EPV context model, Environment, People, Vehicles, as shown in Figure 2: Context for Perceptions of Safety, is an extension of Haddon's Safe System framework (Haddon Jr, 1972) and is consistent with the 'Sustainable Safety' framework used in the Netherlands (Institute for Road Safety Research (S W O V), 2010).

Framework of Safe System factors that effect adult perceptions of safety for short, inner city cycle trips

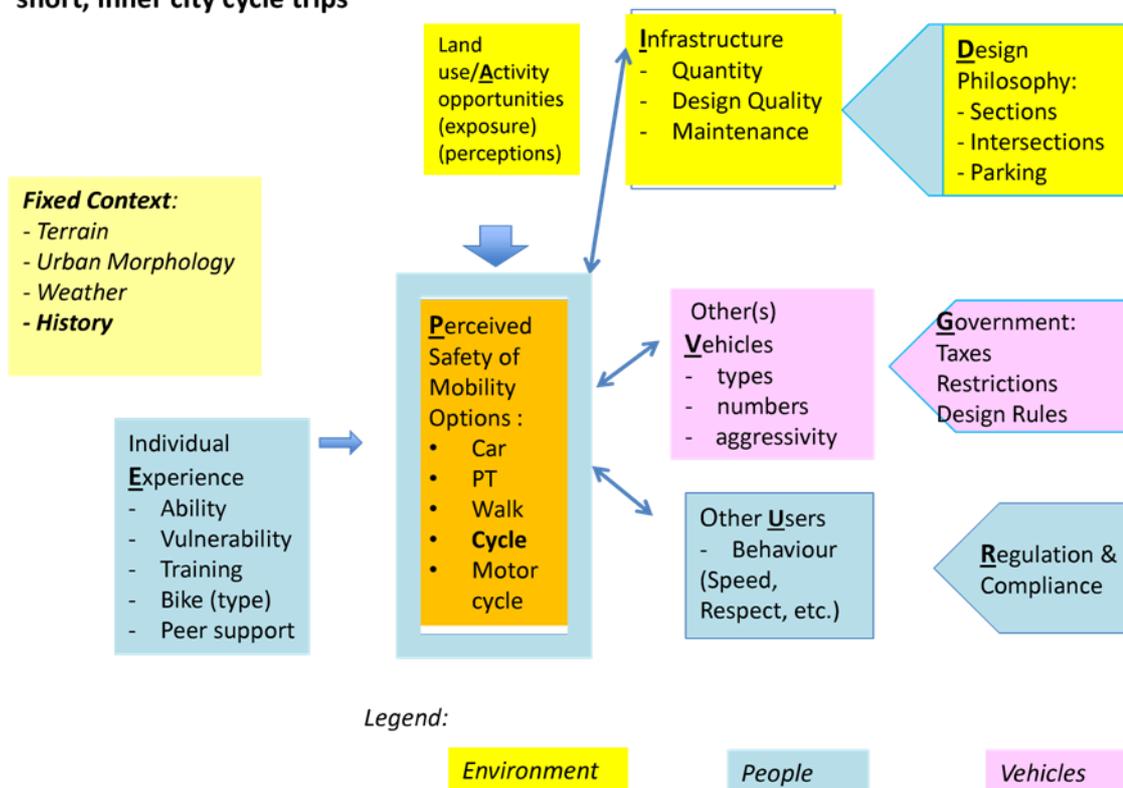


Figure 2 Context for Perceptions of Safety

The above context framework model (Figure 2) shows nine clusters of contextual factors that influence how individuals perceive the safety of cycling. In each city there are fixed contextual factors, including the terrain and weather, which cannot be changed. The other eight factors may however be changed over time by local, state and/or national government programs or legislation and by individual action (e.g. behavior, choice of bike). In both Amsterdam and Copenhagen a wide range of such measures have been undertaken by all levels of government to improve the context for cycling (Pucher and Buehler, 2008, Anderson *et al.*, 2012, Dextre *et al.*, 2014). In Inner Melbourne however, measures appear more ad hoc and actions by municipalities are relatively unsupported by the State and National Governments.

System Factors

In the following discussion, measures are grouped under Environment, People and Vehicles. The measures are intended to inspire, not prescribe. As Neils Jensen from the Cycle Secretariat of the City of Copenhagen says, measures need to be developed that respond to local nuance; they cannot be copied and pasted as the contexts are different between cities and nations (Jensen, 2013 p.137-138).

Environment

1) Fixed Context and History

The fixed context is the factors that are beyond institutional control, like the terrain, weather, and a city's historic fabric (including established transport infrastructure). In the mid-19th century people in each of the three cities relied on walking and horses to access activities, although Amsterdam and Copenhagen also had canals. By the late 19th century the adaption of each city to the mechanisation of transport was very different. Melbourne quickly developed to a rail based 'transit city' with land use strongly influenced by the technology of steam engines. Cable trams in Melbourne grew from the late 1840's to an extensive network by the early 1900's. By the 1860's Melbourne also had five suburban train routes, which, together with the trams, provided a practical and safe means of personal travel for ordinary (non-horse owning) residents. The residents of Amsterdam and Copenhagen were however, dependent on canal barges, walking, limited tram services and then bicycles. There were no suburban trains in Copenhagen until the 1930's and none in Amsterdam until the 1970's. Melbourne's lower density of development, which was led by train and tram services, fostered an initial reliance on public transport rather than cycling and then rapidly adapted to private motor vehicles.

The urban morphology for the 20th century arrival of motor vehicles was very different in the case study cities. Melbourne's wide roads and suburban subdivisions readily accommodated car use such that by 1926 motor vehicles made up 50% of road traffic and by 1947 comprised 90% (Davison, 2004). The inner areas of Amsterdam and Copenhagen however had many pre 19th century narrow streets. In Amsterdam during the 1920s, 80% of typical city rush-hour traffic was people on bikes (Buiter, 2013). On many city streets in Copenhagen until the 1950s, cyclists simply dominated (Jensen, 2009, slide 5). Bicycles were used in Melbourne but never to the same degree as in Copenhagen or Amsterdam. From the 1950's motor vehicles came to dominate the roads in all three cities, but particularly in Melbourne, spurred by an end to car import restrictions and petrol rationing, the growth of a local car industry, and growth in truck traffic serving manufacturing industries, port activities and construction.

By the 1970's automobilisation had created a road safety crisis in most developed countries. WHO statistics (1988) show that in 1970 Australia had the world's highest road death rates for males, 42.3 per 100,000, compared to 29.0 for Denmark and 31.8 in the Netherlands. The road safety crisis was seen and handled differently in each city and country and in ways that profoundly influenced cycling. In Victoria, in 1970 after the highest ever road toll of 1061 people killed, the government's focus was to protect motor vehicle occupants by legislation to require seat belts. In the Netherlands the focus was on the 400 child cyclists and pedestrians who had died in the previous year. The pressure group "Stop de Kindermoord" ("Stop the Child Murder") successfully campaigned for the Dutch government to re-emphasize building of segregated, safe and attractive cycle paths. For Copenhagen the early 1960's to the mid 1970's was the worst period for cyclists with, for example, cycle tracks truncated before intersections to increase capacity for motor vehicles. By the mid to late 1970's however providing a safe environment for cyclist became a political priority in both Amsterdam and Copenhagen with huge demonstrations demanding separate and better facilities. In Copenhagen the turning point came in 1979 with a demonstration of more than 40,000 cyclists demanding more cycle tracks, a proposal that had overwhelming support from ordinary citizens. In the view of one researcher 'the bicycle city of Copenhagen was not developed by the city planners, but by the bicyclists' who kept cycling' (email 22/05/2014).

2) Land use and accessible activities

In Amsterdam and in Copenhagen, there are strong supportive relationships between land use and transport planning that privilege public transport and car restraint. The planning policy of the Dutch government limited the size of Amsterdam by directing development to growth centres, maintaining the older urban fabric of Amsterdam with diverse activities conducive to cycling. No car parking is provided at stations but vast bike parking areas are provided. In Copenhagen development was guided by a 'Fingerplan' (fingers of urban development separated by green wedges – as later adopted in Melbourne) with urban development integrated with stations on radial train lines, but with deterrents to car use that included strict limits on central area parking and high taxes on new cars and fuel. The Danish Manual of Traffic Planning in Cities (provided by one of my informants) states that large cities are to be designed so that there is more bicycle and public transport use than car use (Section 3.2). In both cities there are less cars in the central area and on the road system as provision for cycling has been privileged over provision for cars. Several participants suggested the land use pattern in

Amsterdam and Copenhagen was achievable politically because of heritage and livability concerns. As one said: *'Having less cars makes life in the city more pleasant. There is no real balance between the wish to have a car and use the car and the wish to live in an environment not dominated by the car'* (Copenhagen University Researcher, 2014).

3) Infrastructure Design

A key difference in infrastructure design in Amsterdam and Copenhagen compared to Melbourne is that for many decades their national road design principles and the local municipal guidelines gave priority to the needs of vulnerable road users over the mobility needs of those in motor vehicles. In the Netherlands the National 'Policy Document on Mobility' (2005) directed all provincial and municipal councils to encourage the bicycle as the principal means of transport, particularly for journeys of less than 7.5 km. (Center for Traffic Transport and Infrastructure (CROW), 2007 p.11). The (CROW) Design Manual states that safe infrastructure is important for cycling to be competitive with car use. Cyclist comfort and avoidance of stress is seen as being closely related to safety so that cyclists can concentrate on what is happening, without stress and pressure to make unexpected avoidance maneuvers (Ibid p. 22 & 26). Key principles of the Sustainable Safety vision of the Netherlands are 'predictability', the 'self-explaining road' and 'homogeneity', such that the behaviour expected of road users, particularly speed, is communicated by the visual design of the road and is not reliant on enforcement of speed zones. The homogeneity principle means that traffic with large differences in mass, speed, and direction are either to be physically separated, or if mixed are to operate at a safe (low) speed Institute for Road Safety Research (S W O V) (2012b). In all jurisdictions intersections are a safety challenge. The Dutch see intersections as locations for 'change of direction' (rather than driving through) and are designed for motor vehicles speeds of 30 km/h or less (for pedestrian safety) Center for Traffic Transport and Infrastructure (C R O W) (2007) pp. 184-5). In Amsterdam the Municipalities Leidraad CVC (traffic manual, provided to me by an informant) includes the principles that the main cycling network is to have as few intersections as possible and then at intersections as much priority as possible for cyclists. An issue that has however emerged in Amsterdam over the last ten years is a dramatic growth in injuries from bike only incidents, such that design principles are being rethought.

The Danish Design Manual sees safety as a subjective experience and that if cyclists feel insecure then (unwanted) car use will be encouraged. In design therefore, perceived safety by cyclists is the deciding factor (Section 2.2.4). In Copenhagen, for example, truncating cycling tracks at intersections were trialed but rejected as representing planning for fear, 'to keep cyclists on their toes' (Jensen, 2013) p. 135. Two of my participants in Copenhagen explained that at major intersections, designated and protected separate space and signal times are provided primarily to make cyclists feel safer.

4) Infrastructure Provision

In Melbourne the provision of cycling infrastructure has typically been either on-road with unprotected marked lanes (in speed zones up to 70 km/h) truncated before intersections, or narrow off-road paths shared with pedestrians. Provision of cycling infrastructure has been largely left to municipal governments, with some support from the State government and practically nothing from the National Government. In European cycling cities however, municipalities have typically been supported by regional and national governments to provide separate paths and over recent decades to designate separate safe space and/or time for cyclists at intersections. During the 1980's and 1990's the Central Government in the Netherlands provided funding for many new cycle paths, and from the 1990's for intersection and crossing designs that explicitly considered cyclists. In Copenhagen, gradually over the last 100 years, the protected 'Copenhagen bike lane' was developed. The City has also developed several solutions at intersections, including moving the stop line back for motor vehicles, experimenting with extended areas for cyclists to wait to cross intersections, and channelization with special bike signals providing cyclists with their own lane for right turns (City of Copenhagen website 09/08/2013).

People

5) Experience of users

Individual experience includes the amount of training received in bike riding, awareness of the attributes of different types of bikes, and peer support for cycling. Both the Dutch and the Danes receive extensive cycle training throughout their schooling. Everyone - planners, engineers and politicians - thus know about cycling. The Dutch motoring association (ANWB) understands that without large numbers of people riding bikes it would be impossible for those who need to use cars to get about in cities and that public transport would be very expensive. In Copenhagen, cyclists are

understood to be part of a shared and safe urban environment. Most drivers experience these cities, with many people riding bikes, as quieter, less polluted and more efficient.

6) User behaviours

In Melbourne the majority of serious injuries to cyclist occur at intersections and crossings that are usually the result of conflict with motor vehicles. In mixed traffic, cyclists have several problems, including: being seen, being afforded rights under the rules of the road, being able to undertake avoidance maneuvers and of having their capacities and vulnerabilities understood. In both Amsterdam and Copenhagen my informants commented on how drivers and cyclists understand each other. In Copenhagen for example, at intersections I was surprised to see most drivers stopping and checking for cyclists before turning right (equivalent to a left turn in Australia); the result of a municipal education campaign. A difference between Amsterdam and Copenhagen that my informants commented on was that in Amsterdam cyclists behave like they own the streets while in Copenhagen they are one element of ordered and disciplined traffic. In Melbourne, drivers behave like they own the streets.

7) Regulation

In Amsterdam and Copenhagen there is less reliance on regulations and their enforcement; 'right' behavior is encouraged by design. Designs are checked by Police to ensure that they will not require enforcement to work. As noted above, low operating speeds are achieved primarily by design, not by reliance on regulation. In Amsterdam 90% of all roads have a speed limit of 30 km/h. For roads with a 50 km/h limit or higher, separate cycle paths are usually provided, and, in exceptional circumstances where cycle lanes are simply marked out on the road, the speed limit must not exceed 50 km/h (City of Amsterdam, 2014a). In Copenhagen most local roads have a 30 or 40 km/h speed limit. On roads with a 50 km/h speed limit the norm is for bicycles to be separated by a step/change of level or curb; a 60 km/h speed limit is only allowed if separate bike paths are provided (Danish Road Directorate, 2012?). According to informants, lower speed limits have reduced the number of fatalities to cyclists and the number of injuries to other road users but not cyclists (as serious injuries can occur at low speed if a fall is initiated).

Vehicles

8) Vehicles

The safety performance of different bike designs appears to be neglected in Australia. The Dutch, particularly those observed in Amsterdam and many people in Copenhagen, use upright bikes, with wide tyres, generally designed for comfort not speed. The bikes typically incorporate safety features for riding at day or night and in the wet or dry, with internal hub brakes, generator powered front and rear lights with capacitors that keep lights lit when stopped (e.g. the bike I was lent had sensors so that the lights came on automatically in low light). The Dutch ANWB has been a leader in the design of safe bikes and are continuing to work with the manufacturer Giselle to develop a new safety bike to take advantage of the possibilities of new generation batteries, e.g. to power seats that automatically lower at low speed, to enable riders to put their feet on the ground and thus improve stability.

In Melbourne (and other Australian cities) it is accepted that a wide range of vehicles and users, often with incompatible characteristics and operating speeds, share road space. In Amsterdam and Copenhagen vehicles that are incompatible are either separated or restricted to a speed that is safe for cyclists (Institute for Road Safety Research (S W O V), 2012b). With trucks, interactions involve additional incompatibilities of weight and visibility (Morgan, Dale, Lee and Edwards, 2010, Niewoehner and Berg, 2004). Measures used in Amsterdam and Copenhagen (and other European cities) to improve interactions between cyclists and trucks have focused on truck design and equipment standards to reduce truck blind spots, restricting the routes and times which trucks operate and other measures that improve the safety of many road users and improve city amenity (Mesken and Schoon, 2011).

Several of my participants see vehicle technology as being the key to future road safety. As a senior Victoria Police officer said: *If you don't think ambitiously you will never succeed. Vision Zero is going to be achieved; it's only a matter of time. Not through anything else other than advances in technology: when cars through technology will not crash into other cars and will not crash into road infrastructure and will (either) not crash into other (vulnerable) road users or if they do, severity of injuries will be reduced.* Motor vehicle technology to protect vulnerable road users may however need

to be mandated by Australian Design Rules. My RACV informant noted reluctance by Australian importers to include European safety technology as standard equipment.

9) Government vehicle policy

Amsterdam and Copenhagen have benefited from integrated municipal, regional and national policies aimed at a balanced mix of vehicles: bikes, public transport and cars, including a history of measures involving car restraint that were politically impossible in Australia. Motorists in Copenhagen and Amsterdam have for decades been subject to their National government's high taxes on cars (in Denmark, 180% plus 25% VAT) and on petrol (priced 60% higher than in Australia). Municipal restrictions on parking have also restrained car use. Also, in Copenhagen, from the 1960's, the municipal government improved amenity by progressively removing car parking and pedestrianizing squares and streets; and by metering arterial motor traffic into the central area. These car-restraining measures were motivated by livability concerns and not explicitly intended to promote safe cycling.

Discussion and Conclusions

City cycling has many advantages for short trips, including being low cost and providing incidental exercise. For communities it also yields less congestion and improved livability. A fundamental impediment to more cycling in Inner Melbourne (and several other cities) is, however, that many adults correctly perceive that cycling is not safe.

In this paper I have compared road safety outcomes between modes, between areas of Melbourne and between similar (inner) areas of Amsterdam and Copenhagen. For travel within Inner Melbourne I show that compared to car use or walking, the risk of trauma for a cycling trip is disproportionately high (five to six times higher, as shown in Figure 1 above). For cycling trips in Inner Melbourne compared to Amsterdam, the risk of serious injury is more than 3 times higher (Table 2 above).

By comparing Inner Melbourne with Amsterdam and Copenhagen, within the safe system framework of: environment, people and vehicles, I identified eight clusters of measures that could improve both the reality of and perceptions about the safety of cycling. Governments and road users need to share responsibilities to systematically co-create safe outcomes. For example, to improve safety at intersections: road design and management practices would need to change; as would the Australian Design Rules for trucks (that currently allow long bonneted trucks with poor visibility); cyclists would need to be better informed on how to avoid placing themselves in danger; and drivers need to understand the importance of having due regard to their legal obligations to cyclists. There are thus many opportunities for cities to learn from each other, providing contextual and cultural differences are understood.

In Inner Melbourne, measures to improve cycling safety have largely been driven by individual municipalities. A major barrier to improved cycling safety in Melbourne (and other Australian cities) is the lack of institutional support and coordination at State and National levels. Several key system changes, as have been achieved in Amsterdam and Copenhagen, are beyond the capacity and responsibility of individual municipalities, such as reducing the car dependence inherent in some major re-developments; mandating intelligent safety technology for motor vehicles to protect vulnerable road users; and funding an extended program to develop coherent and separate infrastructure for cycling. For such measures to be politically supported they will probably need to be framed as offering win-win outcomes for the majority. For example, a calmer, quieter, less congested inner city road environment would have many livability benefits, as well as allowing safer city cycling.

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