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Te Ara Mua – Future Streets: Can a streetscape upgrade designed to increase active travel change residents' perceptions of neighbourhood safety?

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ABSTRACT

We aim to understand how a streetscape intervention, Te Ara Mua- Future Streets, designed to improve the ease and safety of active modes, influenced perceptions of neighbourhood safety and security in Māngere, New Zealand. In this controlled intervention study, survey, focus group and in-depth interview data on neighbourhood perceptions were gathered from adults and children in 2014 and 2017, before and after the intervention. General Linear Mixed Modelling (GLMM) was used to undertake a difference in differences analysis of the individual level survey data on traffic and neighbourhood safety perceptions. Focus group and interview data were analysed thematically. Survey data indicate improvements in neighbourhood safety but not traffic safety perceptions after the streetscape upgrade. Conversely, focus group and interview data suggest enduring fears around people and dogs, but an easing of traffic-related fears attributed to safer crossings and slower vehicle speeds. Our contrasting quantitative and qualitative findings demonstrate a complex interplay of neighbourhood people and place attributes in shaping residents' experiences of safety and security, and therefore the importance of combining personal safety and traffic safety, as well as multiple measures, when investigating pathways between built environment change and active travel.

1. Introduction

A substantial mode shift from motorised travel to walking and cycling would have major societal benefits; for health via an increase in physical activity, and to the environment by reducing carbon emissions (Brand et al., 2021). While the potential benefits are clear, how to catalyse a mode shift is challenging in car dependent countries like Aotearoa/New Zealand where suburban neighbourhoods are characteristically low density and poorly served by active travel infrastructure. Retrofitting streets with more supportive infrastructure to increase the ease and safety of active travel is often considered a necessary first step (Charlton et al., 2010). However, whether street environment interventions can change residents' perceptions of neighbourhood safety and sense of security, and in turn their active travel behaviours, is not well understood.

The paper reports on findings from Te Ara Mua-Future Streets (TAMFS), a mixed-methods, controlled before and after intervention study of the effects of neighbourhood scale street changes on a range of health, social and environmental outcomes. The intervention was designed to make walking and cycling to local destinations easier and safer for residents. Māngere, the study location, is a lower socio-economic suburb in Auckland, Aotearoa/New Zealand. Residents' perceptions and experiences of neighbourhood safety and security are the specific focus of this paper drawing on data gathered before and after the intervention via a residents' survey, go-along interviews with key informants and focus groups with children and adults. Prominent safety concerns prior to the intervention related to people, traffic and dogs. In the paper we briefly review literatures we have drawn on at the nexus of urban street design, active travel and safety perceptions before introducing the TAMFS study context and methods. The impact of the intervention on residents' perceptions of neighbourhood safety and security are then presented and discussed.

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2. Background

2.1. Urban design and active travel

There is strong evidence linking attributes of urban street design to physical activity behaviour, including active travel. Living in a walkable neighbourhood with a higher prevalence of design features such as well-connected streets, higher dwelling density, and easy access to common destinations like shops, schools, parks and public transport is associated with higher levels of physical activity than living in neighbourhoods without these features. This relationship has been observed repeatedly across a range of self-reported and objective measures in cross sectional studies in different cities and various countries (McCormack and Shiell, 2011; Sallis et al., 2016; Witten et al., 2012). While the findings of this body of work are informative as new residential areas are planned, it is less clear how the evidence can be applied to transport and planning practice in existing suburban neighbourhoods. Increasing urban density, street connectivity and amenity access (including public transport) may be indicated, but faced with large tracts of existing low-density, sur-burban development these can be long term and costly strategies. In light of the level of investment required, it is prudent to seek evidence on alternative approaches to retrofitting streets to both create safe neighbourhood environments and increase active travel.

The literature on built environment determinants of physical activity has largely emerged through the public health, exercise science and epidemiological fields. Other disciplines have developed alternative approaches for enhancing the safety of neighbourhood streets. Pedestrian crossings and traffic calming measures such as chicanes, narrowed streets and street gateways are common treatments in a transport planners' toolbox and have been successfully applied to improve safety from injury, by modifying driver and pedestrian behaviour (Charlton et al., 2010; Mackie et al., 2013). In this tradition, low traffic neighbourhoods are being developed by clustering traffic calming features with infrastructure to support walking, cycling and public transport alongside measures to reduce the use and dominance of cars (Laverty et al., 2021).

Urban design is also often directed at safety from crime, and sociability of streets and draws on a fusion of environmental design and social change concepts and strategies. Crime Prevention Through Environmental Design (CPTED) is a design and planning process that aims to reduce the incidence and fear of crime and improve community safety. CPTED is premised on the notion that people and activity on a street, and the benign surveillance this offers, can reduce crime and increase personal safety (Bennetts et al., 2017; Cozens and Love, 2015). As practiced in mainstream spatial planning, CPTED has been critiqued as an example of environmental determinism and for contributing to the exclusion and oppression of minority groups (Special ICA Webinar, 2020). In response, deeper engagement and long-term stewardship of CPTED processes by local communities has been advocated, with the goal of building community cohesion and residents' sense of place, ownership and belonging (Cozens and Love, 2015; Special ICA Webinar, 2020). Placemaking is often partnered with CPTED as a social change strategy to engage residents in co-creating design responses tailored to local context and aspirations (Bennetts et al., 2017).

Design features that impact safety and sociability can range in scale. At a micro scale, installations such as street furniture and street art are designed to attract people to inhabit local streets, enhancing conviviality and also safety through an increase in 'eyes on the streets' (Jacobs, 1961; Mehta and Bosson, 2010). At a macro level design features that determine how streets function and prioritise differing transport modes can also impact on street safety and social connections. For example, heavy traffic can result in 'severing' people from each other and from places of importance (Spray et al., 2020).

2.2. Neighbourhood safety perceptions and active travel

Concern for personal safety can be a deterrent to neighbourhood walking. Exposure to traffic, fear of threatening behaviour by others and poorly maintained public spaces are all identified barriers to active travel (Lee, 2013; Van Dyck, Veitch, De Bourdeaudhuij, Thornton, and Ball, 2013). In studies of children's independent mobility and active school travel, traffic-related safety concerns and fear of other people, 'stranger danger', have been identified repeatedly (Carroll et al., 2015; Lin et al., 2017). Unsurprisingly, street and public space-related safety fears tend to be patterned by age, gender and area characteristics, with women, older people and those living in lower socioeconomic neighbourhoods reporting greater concern (Lee, 2013; Van Dyck et al., 2013).

Fear of encounters with dogs can taint neighbourhood safety perceptions and increase car travel as a way to avoid the threat of a dog encounter (Witten and Field, 2019). In contrast, dogs are generally positioned as a positive factor in the physical activity literature due to associations between dog ownership and increased walking and social connectedness (Christian et al., 2013; Cutt et al., 2007; Wood et al., 2017).

Mixed relationships have been observed between neighbourhood design features, objective and subjective measures of safety from traffic and crime, and physical activity levels (Bracy et al., 2014; Van Dyck et al., 2013). The longitudinal RESIDEntial Environment Study (RESIDE) in Perth, Australia has been particularly informative, with findings indicating residents felt safer in more walkable neighbourhoods (Foster et al., 2010). Alongside higher street connectivity, neighbourhood aesthetics, and access to parks and beaches, safety from crime was identified as an independent determinant of recreational walking (Christian et al., 2017). However, an objectively measured safe place (based on reported crime) may be different to a place experienced subjectively as safe by residents (Cutts et al., 2009; Foster et al., 2016; Kyttä et al., 2014). Analyses of longitudinal data from the RESIDE study suggests a causal relationship between an increase over time in participants' fear of crime – a subjective response - and a decline in time spent walking for transport and recreation (Foster et al., 2014). Various findings of the RESIDE study support the view that walking is influenced by a melding of neighbourhood people, place and traffic perceptions and attributes, both as they are subjectively experienced and can be objectively measured. Understanding how perceptions of personal safety and traffic safety cohere to undermine or support walking in different residential environments will be important if gains are to be made in walking mode share.

2.3. Sense of place and active travel

Subjective experiences of the material and social characteristics of home neighbourhoods, including how they influence perceptions of safety, have long been theorised as a determinant of health behaviours and health inequalities (Cummins et al., 2007; Curtis and Rees Jones, 1998; Graham, 2000). To describe subjective meanings attributed to place, Gesler (1992) coined the term 'sense of place' – an affective alchemy of material, cultural, social and emotional influences. Drawing on the notion of sense of place, Popay et al. (2003) posited that social meanings of place are constructed and shared by people living within a neighbourhood in ways that shape health-related actions. They identified circumstances where people's experiences of their neighbourhood were dissonant with their understanding of the attributes of a 'good' or 'proper' place. Narratives of place, positive and negative, converged around 'people living in places; the facilities, opportunities and resources available in places and a sense of belonging' (p. 59). While discrepancies between people's experiences of place and their notions of a good or proper place varied across neighbourhoods, they were more common in disadvantaged neighbourhoods (Popay et al., 2003). Strategies identified for coping with discord between personal values and observed neighbourhood practices included withdrawing or

demarcating self (and family) from others through physical or discursive distancing and/or denouncing the behaviours of others in the neighbourhood (see also Thomas, 2016; Wacquant, 2007). Conversely, a deep sense of belonging to place can buffer an individual's experience of value-place dissonance and spur resistance to negative place-labelling (Kirkness, 2014; Thomas, 2016). To speculate on the salience of these strategies for neighbourhood active travel, a decision to walk rather than drive is unlikely for households wanting to distance themselves and avoid encounters with others, whereas active travel may sustain connections and belonging for those with a strong sense of place.

2.4. Inequality, spatial stigma and neighbourhood safety

As Popay's (2003) study showed, social meanings of places, shaped and shared by residents, can influence health-related behaviours and when meanings are tinged with fear, venturing far from home can be curtailed. Further, as Keene and Padilla (2014) observe, if negative social meanings or representations of disadvantaged neighbourhoods are picked up and rehearsed by outsiders, and the media, these areas can become maligned and imbued with spatial stigma. Keene and Padilla (2014) argue that this stigma or 'blemish of place' (Pearce, 2012; Wacquant, 2007) can be embodied by residents in ways that influence 'their sense of self, their daily experiences, their mobility beyond their communities, and their relations with 'outsiders' (Keene and Padilla, 2014, p. 393).

Spatial stigma has been theorised as arising from, and maintained by, social inequalities through pathways akin to those that drive health inequalities, such as poor housing, poverty, racism and a lack of investment in public infrastructure (Pearce, 2012; Sampson and Raudenbush, 2004; Wacquant, 2007). Neighbourhood features that contribute to spatial stigma are often similar to those that impair residents' perception of the safety and security of their neighbourhood, for example, poorly maintained streets and public spaces and evidence of antisocial behaviours (Groshong et al., 2018; Hassen and Kaufman, 2016). Higher rates of rental tenure (greater than 36%) has also been associated with increased prevalence of feeling unsafe (Badland et al., 2017). And in Sampson and Raudenbush's (2004) Chicago neighbourhoods study, independent of objectively measured characteristics of neighbourhood disorder, perceptions of disorder increased as deprivation and minority group racial concentration increased.

Our concern is with public health and transport geographies, recognising that entrenched automobility and limited or unsafe active and public transport networks impact public health through reducing opportunities to be active, contributing to unequal social and employment opportunities (Hawley et al., 2020) and deepening place-based disadvantage. Conversely, safe and effective transport networks may reduce these inequities of place. However, evidence is sparse on whether transport design interventions can alter perceptions of neighbourhood safety – personal and traffic-related – and/or affect a change in travel behaviours. Our aim in the paper is to contribute to this evidence base regarding perception of neighbourhood safety.

2.5. Context: Te Ara Mua – Future Streets

TAMFS is a neighbourhood scale, streetscape retrofit designed to improve safety on roads, footpaths and greenways routes and encourage healthier mobility options, particularly walking and cycling (Macmillan et al., 2018). The study design reflects a complex causal theory that synthesises evidence about the multiple pathways between street changes and active travel, including the evidence outlined in the previous section about pathways through neighbourhood safety perceptions and sense of place (Macmillan et al., 2020). It is also a controlled intervention study with intervention and control neighbourhoods located in Māngere, Auckland, Aotearoa/New Zealand. Auckland is New Zealand's largest city, with a population of 1.6 million. It has a sprawling, low density urban form, high car dependency and low rates of active travel. In 2013, only 6.5% of Auckland commuters used active travel modes (StatsNZ, 2014).

Māngere, developed in the 1950s and 1960s as a dormitory suburb, is 17 km from central Auckland. It is a predominantly Māori (indigenous New Zealanders) and Pasifika community with a young population relative to other areas of the city. A high proportion of household are low income and home ownership rates are also low. Of the 58% of households who rent in the Māngere - Otāhuhu Local Board area, just under half rent from a public housing agency (Auckland Council, 2016). In 2013, Māngere was selected as the study location, in part, due to inequities in transport-related health outcomes experienced by its residents: road traffic injuries rates were amongst Auckland's highest (Hosking et al., 2013). The diabetes rate at 17.3% is over twice the Aotearoa/New Zealand average (Warin et al., 2016).The demographic profiles of residents in the intervention and control areas are comparable and so are the street layouts.

The Māngere area does not have the urban and street design attributes of urban density and street connectivity associated with a walkable neighbourhood. Rather, it has low dwelling density and a curvilinear street network characterised by cul-de-sacs branching off collector roads and narrow alleyways linking cul-de-sacs to greenway routes and other residential streets. In partnership with the regional transport agency, Auckland Transport, TAMFS aimed to improve road safety and the active travel environment, through both transport infrastructure and place-making.

The intervention was developed using a co-design process involving local residents, community stakeholders, mana whenua (Māori with ancestral ties to this area), transport professionals, the Māngere-Otāhuhu Local Board, and our team of transport and health researchers (see Macmillan et al., 2018), while also drawing on the evidence about what makes for successful street changes, especially the psychological principles behind Self-Explaining Roads (Charlton et al., 2010; Mackie et al., 2013).

The study can be considered a complex public health intervention, with a range of intermediary environmental, social and health and wellbeing outcomes being measured, in keeping with our *a priori* causal theory. These include traffic speeds and volumes, resident perceptions, traffic crashes and injuries, travel patterns, road user counts and behaviours, and air pollution (Macmillan et al., 2018).

Safety and security-related concerns voiced during consultation and co-design processes centred on traffic speeds and volume, difficulty crossing roads, roaming dogs, and people-related fears particularly on off-street, greenway routes. Safety hotspots for injury and crime were identified, and children and people with disabilities were seen as particularly at risk. CPTED principles were incorporated as co-design concepts progressed to developed designs in areas such as lighting, benign surveillance, planting profiles and walkway dimensions. In brief, the intervention included traffic calming measures, safer crossings, a landscaped two-kilometre fitness trail on greenways routes and a mix of on-road and separated cycle lanes. Fig. 1 (from Mackie et al., 2018) illustrates the key elements of the Future Streets intervention.

Guidance from mana whenua, in keeping with Māori cultural landscape design principles (Hoskins et al., 2008), ensured the improvements reflected the identity of Māngere people (Raerino et al., 2021).

Analysis of pre- and post-intervention video recordings indicate interactions between pedestrians and motor vehicles shifted to lower-energy, safer locations and provide evidence of safer crossing behaviours where new or improved crossing were installed (Hirsch et al., 2019). Also, analyses of data gathered using pneumatic road tubes indicate traffic speed and volumes on local streets treated in the intervention area reduced relative to the control area (Smith et al., 2019). Papers reporting these data are under review.

The project's research arm is measuring change over time in a range of behavioural, perceptual and environmental factors (for protocol see Macmillan et al., 2018). The selection of measures was informed by a causal theory that links understandings from the literature about active

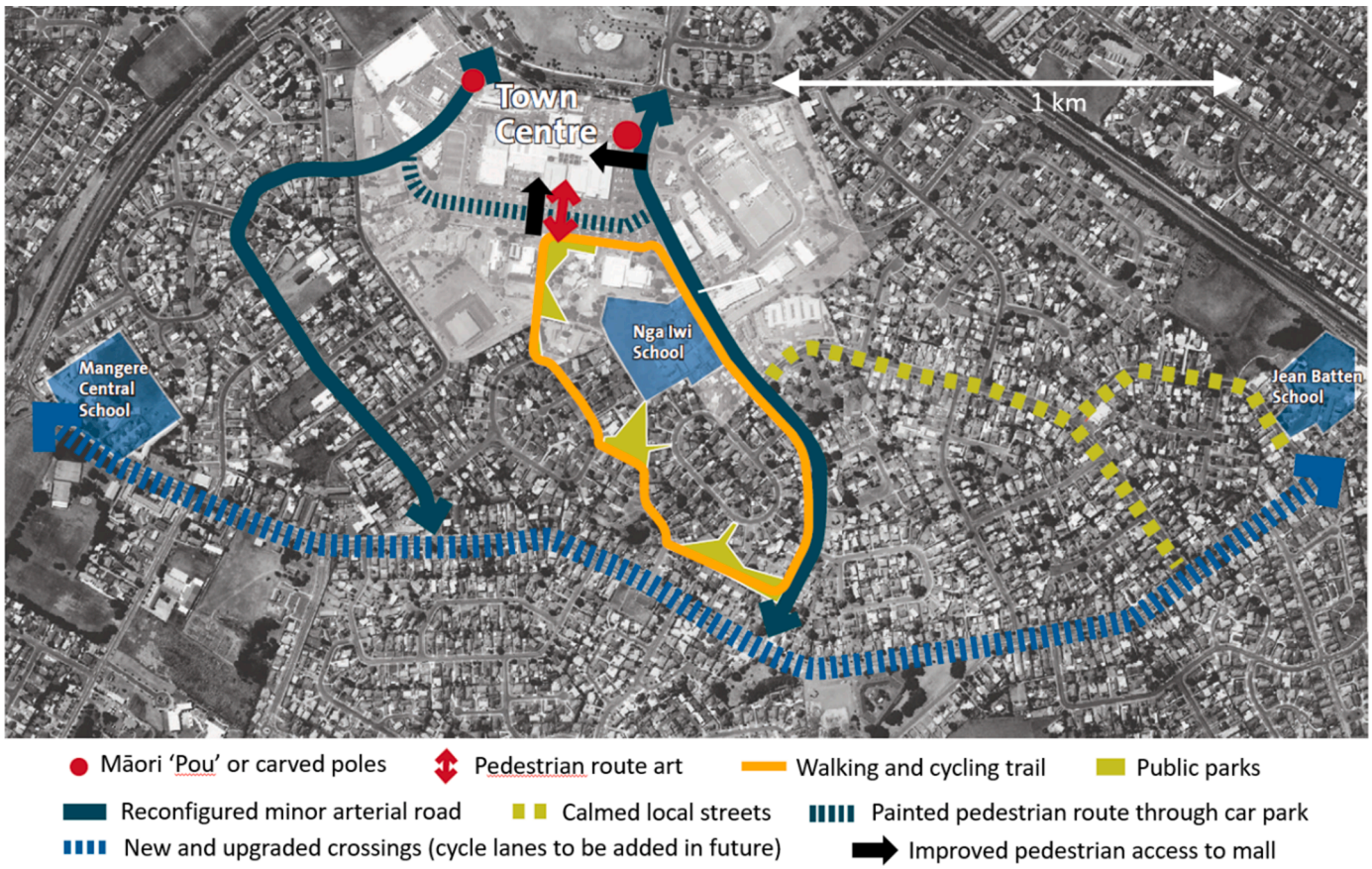

Fig. 1. Key Future Streets interventions in Māngere Central.

travel, neighbourhood perceptions, inequalities and urban design, using qualitative system dynamics modelling. Safety from injury walking and cycling and sense of security – "freedom from the threat or fear of harm or danger" (NZ Stats social indicators definition) were Māngere community concerns and are incorporated in the causal model (Macmillan et al., 2018). Ethical approval was obtained from University of Auckland (Ref. 010723)

3. Methods

3.1. Data collection

This paper draws on data relating to perceptions and experiences of neighbourhood safety and security gathered via face-to-face surveys with residents in 2014 and 2017 (pre- and 6 months post-intervention), focus groups with children in 2014 and 2017 and with adults in 2017, and during go-along interviews with residents and other local stakeholders prior to and following the intervention.

3.1.1. Residents' survey

The TAMFS longitudinal survey involves a random sample of adult and child residents living in the intervention and control areas. In 2014 all households in the areas were visited and enumerated so that individuals could be randomly selected and invited to participate. This procedure avoided clustering by household. Probability of selection, different for children and adults, was pre-determined based on Census population data and an expected response rate. In 2017 all households with a member who had participated in 2014 were revisited. Participating members were invited to take part again and, to replace those lost to follow-up, a replenishment sample was also recruited from the same households, using the same probability of selection as in 2014. With several waves of survey data collection planned the sampling strategy retains a longitudinal sample while adding individuals at each wave who will be invited to participate in all subsequent surveys. Replenishment sampling also enables additional children 7–14 years to be recruited as the older aged children move into the adult sample (14+ years).

The survey was conducted by an interviewer face-to-face with individual adults and caregiver-child dyads. English, Samoan or Tongan versions were available (see Macmillan et al., 2018). Baseline and follow up survey data collection was scheduled street by street and matched by month to control for seasonal effects.

Neighbourhood safety and security perceptions were measured using items from the Ranui Action Survey (Sampson and Raudenbush, 1999) as follows:

Thinking about your neighbourhood in general, not just traffic
R1. There are safe places for children to play in your neighbourhood
R2. It's a good place to bring up children?
R3. You feel safe walking down your street after dark?
R4. You worry about the number of crimes committed in your neighbourhood?
R5. Graffiti and vandalism are problems?
R6. Roaming dogs are a problem in your neighbourhood?
R7. Bullying is a problem in your neighbourhood?
For traffic safety, the following items from the Neighbourhood Environment Walkability Scale (NEWS-A) were used (Cerin et al., 2006):
AN5. There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in your neighbourhood?
AN6. Most drivers exceed the speed limits while driving in your neighbourhood?

AN7. It is safe for children to walk or cycle around your neighbourhood?
AN8. Your neighbourhood streets are well-lit at night?

Response categories for all items in both scales were 4 point Likert scale: strongly disagree, disagree, agree, strongly agree. Items in each scale were averaged to yield a mean score for each scale. Indices were formed for perceptions of safety and security and traffic safety by combining average scores for individual items. For example, scores for seven neighbourhood safety and security items (R1–7 above) were averaged to form an index with a continuous score. Items R4, R5, R6 and R7 were reverse coded. Don't know/prefer not to answer were not treated as part of the score. Scores with </= 1 missing value were included (those scores with 1 missing value were added and divided by 6 rather than 7)

3.1.2. Focus groups and walking interviews

Focus groups were held with children and young people in the intervention area before and after the street changes. Discussions centred on routes and modes of travel to school and other destinations, experiences en route, local play spaces, places and streets where they felt safe or unsafe and why, and enablers and barriers to active travel. Post intervention focus groups also explored participants' knowledge of, and responses to, the street change interventions using before and after photographs. Three groups (boys only, girls only and mixed gender) were held with children aged 9–11 years and one mixed gender group was held with students 13–15 years. Seven or eight children/young people participated in each group. Aerial maps and photographs of the neighbourhood were used as an elicitation device and starting point for conversations.

Three focus groups of eight adult residents were held post intervention with 2017 survey respondents who had indicated a willingness to be re-contacted; one group was women only, one men only and a third involved men and women who had reported having a disability. Unprompted responses to the interventions were sought first, followed by questions relating to mobility and mode choice as before and after photographs of specific intervention sites were displayed.

Go-along interviews were undertaken pre and post-intervention with eight key informants who lived or worked in the intervention area. Interviewees included residents, business people and service providers (e.g., police, health care workers). Interviews were conducted seated while viewing an area map and while walking or wheeling (if using a wheelchair) through selected neighbourhood streets (Carpiano, 2009). Perceptions and use of local places, access to local destinations, and enablers and barriers to mobility, including active transport were explored in semi-structured interviews. Walking/wheeling routes were mapped and, where relevant, photographs taken by interviewees.

All focus groups and individual interviews were audio-recorded and transcribed.

3.2. Data analysis

3.2.1. Residents' survey

We hypothesised that the TAMFS intervention would improve adult and child perceptions of neighbourhood safety and security and traffic safety. To make explicit our understanding of causality and confounding and guide the analyses of survey data directed acyclic graphs (DAGs) were formulated using DAGitty (Diez Roux, 2004; Textor et al., 2017). Fig. 2 illustrates the DAGs for perceptions of neighbourhood safety and security, and for perceptions of traffic safety. Explanatory variables included in regression models were location (intervention/control), age band, gender (binary), ethnicity, social cohesion, and years of residence in the area.

General Linear Mixed Modelling (GLMM) was used to undertake a difference in differences analysis of the individual level survey data, including random effect terms accounting for within person correlation over time. The mean outcome scores for the neighbourhood safety and security, and traffic safety scales in 2017 in the intervention area were compared to the 2014 mean outcome scores in the intervention area and to the mean outcomes scores in the control areas in 2014 and 2017. Separate unadjusted models for adults and child/caregiver dyads were developed. For the analysis of perception of safety and security we were able to also develop models that included all confounders indicated in the DAG. Because we postulated that social cohesion acts as both a mediator and a confounder (see Fig. 2) in the relationship between the intervention and perceptions of safety and security, we also ran models excluding social cohesion. For the traffic safety analysis, only individual level confounding and mediating variables were able to be included

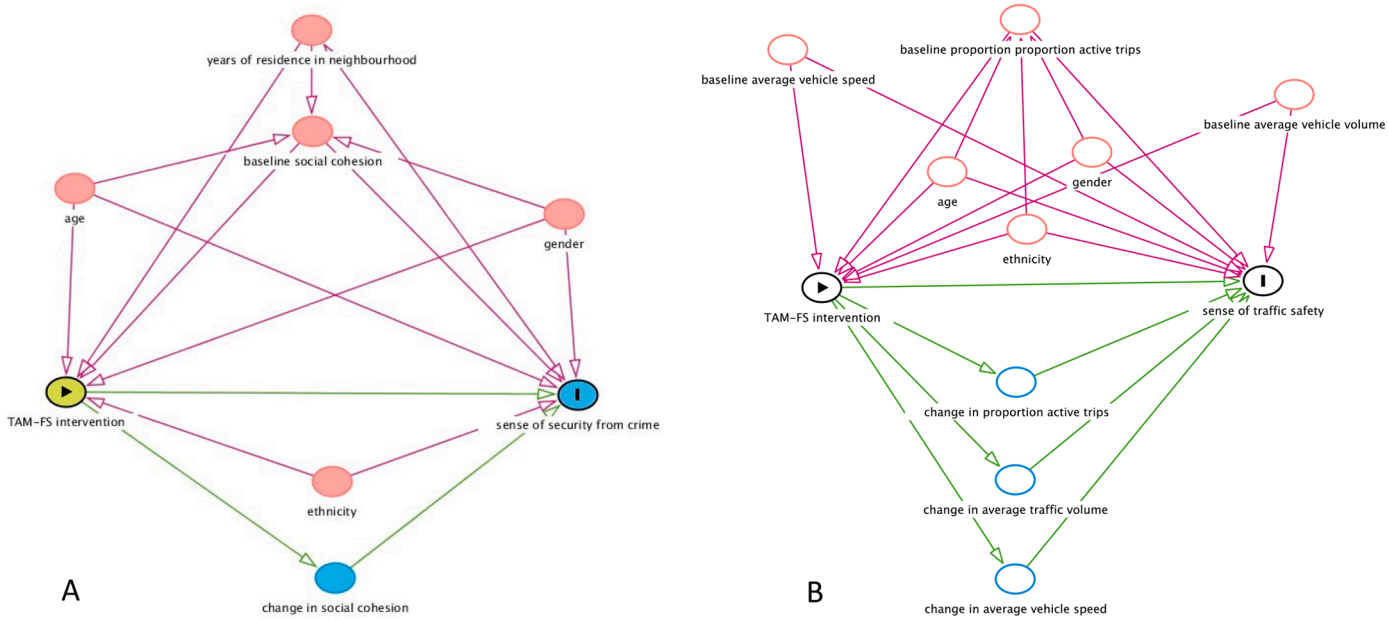

Fig. 2. Directed Acyclic Graph (DAG) for A. TAM-FS effect on perceptions of security from crime and B. TAM-FS effect on percpetions of traffic safety (green lines indicate causal pathways, red lines indicate confounding).

(average vehicle speed and volume data were not able to be modelled). For all the adjusted analyses, interactions were tested amongst all confounders and between confounders and the intervention effect. Modelling also included sensitivity testing to analyse whether the replenishment sample altered the direction and magnitude of the intervention effect.

3.2.2. Focus group and go-along interview data

Data from the children and young persons' focus groups were combined for analysis but pre and post intervention data were analysed independently (Witten and Field, 2019). Adult focus group and go-along interview data were combined in analyses. A coding frame was developed through thematic mapping after multiple reading of transcripts (KW/AF). Data were then coded using NVivo and an inductive thematic analysis undertaken (Braun and Clarke, 2006).

4. Results

4.1. Residents' survey

In 2014, 1234 adults and 658 children participated, with overall estimated response rates of 52.3% and 66.4% respectively, and in 2017, 1275 (441 longitudinal) adults and 628 (250 longitudinal) children participated, with estimated response rates of 56.7% and 62.2%. Table S1 in the supplementary material summarises the demographics for the adult and child/caregiver sample populations at the two time points. On the whole, the populations were demographically similar between the intervention and control groups, across the two time points, and between the longitudinal and replenishment samples.

Because the repeat and replenishment samples were close demographically, and there was no difference in the direction and magnitude of effect sizes between them, data for the two groups were pooled in a single analysis. Baseline social cohesion played an important confounding role in the models, while the sensitivity analysis showed its mediating role was minimal. We therefore report fully adjusted models including social cohesion.

Mean scores between the two areas were similar at baseline (Table 1). Results of the GLMM models are reported in Table 2. Accounting for all theorised confounders, there were small but significant improvements in mean scores for perception of neighbourhood safety and security in the intervention area between baseline and first follow-up compared with the control area, for both adults and children, with a greater improvement for children (10% relative improvement on baseline mean score) than adults (5% relative improvement). The improvement differed by gender in the adult sample, with men perceiving a greater improvement than women.

Adult and children's mean scores for perceptions of traffic safety were very similar between the areas. Adult men had higher perceptions of traffic safety than women. There was no change in perceptions of traffic safety over time in either area, and no intervention effect was detected.

Table 1
Mean scores for perceptions of security and safety from crime, and perceptions of traffic safety before the intervention and at early follow up. CI confidence interval.

	Sample group	*2014*		*2017*	
		n	*Mean score (95% CI)*	*n*	*Mean score (95% CI)*
Perception of security and safety from crime	Intervention adults	656	2.68 (2.52–2.84)	697	2.77 (2.61–2.92)
	Control adults	580	2.67 (2.52–2.83)	680	2.68 (2.52–2.84)
	Intervention children	327	2.77 (2.65–2.89)	315	2.87 (2.75–2.99)
	Control children	282	2.71 (2.59–2.84)	198	2.66 (2.53–2.78)
Perception of traffic safety	Intervention adults	656	2.44 (2.02–2.86)	697	2.45 (2.03–2.87)
	Control adults	580	2.30 (1.88–2.72)	680	2.31 (1.89–2.73)
	Intervention children	327	2.55 (1.76–3.33)	315	2.47 (1.69–3.25)
	Control children	282	2.32 (1.54–3.10)	198	2.25 (1.46–3.03)

4.2. Children and young people focus groups (FG)

Children walked with friends, siblings and other family members but walking alone was neither desired by most children nor allowed by their parents.

> …my mum says that it's not actually safe to walk around these streets because bad stuff has happened (FG girls 9–11 years)

Prior to the intervention, difficulties crossing roads safely, fears about violence and bullying by older youth and encounters with roaming dogs were children's main concerns. On the roads, they worried speeding drivers would not look out for them and they talked of crashes involving injuries to local children. Parks, alleyways and dead-end roads were often identified as scary places (Witten and Field, 2019). Coming upon groups of young people who had been drinking was a specific concern and they described incidents when they had felt threatened.

> …my park sometimes it is dangerous cause there is a group of boys in a gang they always drink there and sometime when another group … looking for a fight and then they throw bottles… (FG boys 9–11 years)

Alleyways, "really long, slim and scary" (FG mixed gender 9–11 years) were especially worrying and the prospect of encountering unfriendly dogs or people, put many children off being out and about.

Contrary to the survey findings, group discussions held after the intervention suggested a reduction in children's traffic-related fears. Crossing the road had become easier and speeding traffic was of less concern. They liked the raised tables, calling them 'speed bumps' and thought they helped slow the traffic down and made crossing safer.

> …cars slow down and before there was just a crossing and no speed bumps so they could just keep going and hit someone. (FG boys 9–11 years)

While children's comments indicated a positive change in perceptions and experiences of traffic-related safety, fears around encounters with aggressive dogs and people you "don't want to be around" (FG girls 9–11 years) were largely unchanged. Alleyways and reserves were still feared, despite new landscaping and amenities that had made them "more stylish and cool" (FG mixed gender 9–11 years), and assaults that had occurred several years before still lingered in children's talk.

Like the younger participants, the older students' perceptions of traffic-related safety had also improved post-intervention. However their people-related safety concerns remained and the way they spoke of local people and places had characteristics in common with the distancing strategies identified by Popay et al. (2003). At times their observations were couched as criticisms of particular groups of local people, and at other times, neighbourhood features were foregrounded to differentiate 'subtle cartographies of difference' (Popay et al., 2003).

> yeah and further down where I stay because it's different to, I don't know but like it has different shops, and like kind of like it has nice restaurants, it's different to Māngere Town Centre…it's the same but like different. (FG mixed gender 13–15 years)

The Town Centre is at the heart of Māngere community. As the following excerpt illustrates, these young people felt uneasy in the

Table 2
Results of the GLMM model for perceptions of security and safety from crime, and perceptions of traffic safety. CI confidence interval. *significant at $p < 0.001$.

	Model	*Adults* Difference in mean score (95% CI)	p-value	*Children* Difference in mean score (95% CI)	p-value
Perception of security and safety from crime	Unadjusted	0.16 (0.10–0.22)	<0.001*	0.28 (0.18–0.38)	<0.001*
	Fully adjusted	0.13 (0.07–0.19)	<0.001*	0.21 (0.11–0.30)	<0.001*
Perception of traffic safety	Unadjusted	0.00 (−0.07–0.07)	0.998	0.01 (−0.12–0.11)	0.825
	Fully adjusted	0.00 (−0.07–0.08)	0.972	0.00 (−0.10–0.13)	0.965

Centre noting gang-affiliates hung out there and shoplifters' photographs were on display.

> You feel uncomfortable around them.
>
> Yeah you feel like, is something going to happen?
>
> … like a lot of kids like steal from the Countdown there. Shoplift and stuff, and it's just embarrassing, like just walking down our main centre, and like you just see peoples pictures, you just don't want to be there.' (FG mixed gender 13–15 years)

A positive change in the safety of the physical environment was contrasted with a perceived lack of change in the social environment.

> What they're doing with the road is good because, it puts us all in safety, but it doesn't change how Māngere is like… You can't change people. (FG mixed gender 13–15 years)

Yet, the students also expressed a loyalty to place and, as the following comment indicates, a reticence to criticise others:

> I don't know how to say it respectfully, not judge them but… (FG mixed gender 13–15 years)

4.3. Adult focus groups and walking interviews (WI)

Adults' perceptions of the safety impacts of the intervention echoed those of children. New pedestrian crossings and slower traffic were commonly seen to have made streets safer, especially for children.

> 'Actually I think it's a lot, it's a lot safer, you know car wise and things because now the cars will stop for you, before they wouldn't stop' (WI Older resident)

The smoother footpaths, more negotiable curb cuts and new pedestrian routes to the town centre were noted to have made getting out and about safer for older residents and people with mobility impairments. Fig. 3 illustrates pedestrian access to the town centre pre and post intervention. The pre-intervention photographs were taken during a wheeling interview.

Adult perceptions tended to be mode sensitive. When walking, most liked the increased ease and safety crossing streets and aesthetic improvements in the streetscape, but as drivers they niggled about loss of parking and narrower roads and new crossings making progress slow on certain roads. As one interviewee put it: '…do you want safe pedestrians, or do you want agitated drivers?'(WI Business woman). There was tacit recognition that adapting to the changes may take time, for drivers and pedestrians.

Intervention designs included cultural landscaping, native planting, lighting, wider footpaths and public art and these aesthetic improvements were appreciated: "it's beautiful looking now"(FG Disabled people). As evident in the following comment, a more attractive environment gave utility and pleasure and contributed to neighbourhood pride.

Fig. 3. Pedestrian access to the town centre pre and post intervention.

'It feels better …the walk part [path] is bigger, … the yellow spots and all that, you know it's friendly… if I had to bring a stranger from overseas I could walk through this park with that person it's more friendly environment'. (FG Women).

Upgrades to make off-street routes safer and more accessible for people with pushchairs and wheelchairs were generally lauded, but there had been downsides of removing bollards and widening footpaths. A hike in the number of shopping trolleys being dumped in surrounding streets was reported as well as motorbikes and even cars using the widened alleyways as short cuts between streets. A police interviewee commented on the safety and security implications of the off-street paths being used as get away routes:

'I would have liked to have seen a chain or something across there, and so if they do go through at high speed that's you know game over'. (WI Policeman)

Some community practices had been slow to adapt. It was noted that on market days, stalls continued to occupy space that had been clearly delineated as a safe pedestrian access way through the town centre car park. Reflecting on the success or otherwise of the intervention a resident said: 'I get it but you know, a lot of people still don't' (WI Business manager). While this comment was directed at the overarching goal of the intervention, the following quote from a man supportive of the intervention, because of the safety benefits for children, appeared not to understand the purpose of the 'bars' separating cyclists from motor vehicle lanes was to create a safe cycle lane and not to provide a space for cars to park.

'..the cars stay away from them [children] and if they do have a go at the kids, they just get blocked by the bars, but at the same time it's unsafe because the cars have to park behind those bars, and closer to the footpath'. (FG Men)

To stop a circular street being used as a racing circuit the street was blocked to vehicles at one point with landscaped build outs to create a cycle/pedestrian only route. A resident, who agreed the intervention had stopped the offending behaviour readily acknowledged she drove up the footpath to bypass the closed section of her street.

I'm going to my mates place just around the corner so why should I go right round when I could be shortcutting….Here's me talking about the young generation these days and I'm one of the culprits that want to do that kind of thing… it's not just me, it's everyone else that actually lives there (FG Women)

As well as entrenched automobility habits, as illustrated above, uncertainty on how to use new infrastructure and resistance to change appeared to maintain driver practices that were reducing the safety benefits of the intervention. In keeping with the views of children, off-street greenways, routes and alleyways were seen as enduring safety hotspots for people-related safety fears.

Notwithstanding the downsides mentioned, overall there was strong agreement amongst participants that the intervention had improved traffic-related safety and the landscaping and other aesthetic enhancements had made the neighbourhood more attractive to residents and outsiders. However, these changes had not quelled perceptions and anxieties about the threat of harm they, and especially children, may face from the anti-social behaviours of others. While viewpoints varied, it was not uncommon for a strong loyalty and sense of belonging to Māngere to be shared alongside disparaging views about local people and places. The interwoven nature of this discourse can be seen in the following exchange in the women's focus group.

It's not a bad place but they always say it is, I mean

It's not a bad place, Māngere is not a bad place, only the people

I like Māngere, it's the best

They need to upgrade Māngere town centre really, really bad…. I mean what are they waiting for, all of us to die…

In summary, the quantitative and qualitative findings provide contrasting assessments of the short term outcomes of the intervention on perceptions of traffic and neighbourhood safety. Child, adolescent and adult focus group discussions indicated a reduction in neighbourhood traffic-related concerns following the intervention. However, survey data detected no significant change over time in perceptions of traffic safety. Conversely, survey data showed an improvement in perceptions of neighbourhood safety and security in the intervention area between baseline and early follow up, whereas focus group findings for all age groups indicate enduring concerns around neighbourhood safety and security.

5. Discussion

TAMFS is a built environment intervention in an area where the wellbeing of many individuals and households is undermined by structural inequalities that manifest in domains such as housing, education, employment and health. TAMFS, by increasing opportunities for safe and easy active travel, aims to lift rates of physical activity and improve health and reduce health inequities. This early follow-up analysis of social perceptions highlights the complex interplay of attributes of neighbourhood people and places, and the likely complexity of pathways between built environment change and an increase in active travel. The intervention was in a suburban setting. Frequently there are differences between inner-city neighbourhoods and those located in peripheral, suburban areas that are relevant to perceptions of safety. These include provision of convenient and accessible public transport, quality of parks and other public spaces, levels of maintenance and repair, and streets that welcome walking and cycling (Witten et al., 2011).

In economically marginalised places, previous studies suggest material improvements are best coupled with social interventions to maintain people's connections to place, build a sense of collective agency and contribute to positive self and place identity (Keene and Padilla, 2014, 2018; Popay et al., 2003). The success or otherwise of the TAMFS intervention is likely to be entangled with the social attributes of place. Our analyses suggest feeling safe, without fear of harm or danger, will be critical and that the new infrastructure and CPTED approach applied thus far, while necessary, have not yet been sufficient to overcome concerns, especially those held by children and parents. As well as traffic and people-related fears, wandering dogs were an impediment to active travel in Māngere. This is likely to reduce the physical activity benefits of dog ownership that have been observed elsewhere.

A striking feature of the data presented is the disjuncture between survey findings on neighbourhood safety perceptions and the perceptions and subjective experiences expressed during individual and focus group interviews. The positive change in traffic safety remarked on by adults and children alike during group and individual interviews, and indicated by reduced traffic speeds and volumes in local streets, was not reflected in survey findings. An explanation, and limitation of the research, may lie in a disconnect between the safety improvements residents talked about – more pedestrian crossings and increased confidence that traffic would stop – and survey items that were directed at traffic speed and volume and street lighting. Although increased safety for children was frequently noted as a benefit of the intervention during interviews, this does not necessarily equate to a positive response to the survey item – 'It is safe for children to walk or cycle around your neighbourhood?' While safer, it may still not be 'safe enough' and a lack of safety may be attributed to other than traffic. A converse pattern was evident for perceptions of neighbourhood safety and security. Survey findings indicated a small but significant improvement in the intervention area compared to the control area, yet concern about neighbourhood safety and security, particularly related to anti-social behaviour and threatening dogs, remained strong in post-intervention interviews.

This discrepancy is less easy to explain, as unlike the index for traffic safety, the content of survey items on safety and security reflect local discourse. One possibility is that residents' appreciation and pride around the intervention's aesthetic and amenity enhancements, designed to reflect local history and culture, found positive expression through responses to survey items on neighbourhood perceptions of safety and security.

The contrasting quantitative and qualitative findings reinforce the value of multiple forms of data to understand the complexity of community perceptions and also the care and caution needed to take account of the temporal and social context of data collection. The focus groups elicited 'all-things-considered' views on whether neighbourhood safety had changed for the better, while the survey data were a point in time, scored response to a limited item set, based on a pre-existing validated instrument. A novel aspect of the paper is the linked reporting of perceptions of personal safety and traffic-related safety. This has revealed the interrelatedness of aspects of neighbourhood safety and security that temper neighbourhood experiences and potential for active travel.

In the study's causal model (Macmillan et al., 2018, 2020), cultural landscaping contributes to an increase in the attractiveness of neighbourhood places to residents, which in turn increases place attachment and the presence of people on the street as one pathway to improved sense of security and social cohesion. While sense of security has increased, at least in survey findings, video monitoring of the presence of people on the street indicates that, thus far, numbers have not (Mackie et al., 2018). These inter-relationships between people and place attributes, and the temporal aspects of behavioural change, need to be better understood to inform locality-based, health-related behaviour change interventions (Thompson et al., 2019). So too the mix of cultural landscaping and micro scale street interventions that will support a greater presence of people in the street. Micro scale features like seats to encourage lingering and conviviality and increase the comfortable walking distance of people who are older or have a mobiity impairment were not included in the intervention. As a longitudinal study these findings can contribute to iterative improvements to the active travel environment.

Māngere residents talked about neighbourhood people, and disturbing behaviours, in ways that resonate with the strategies of distancing and othering identified in earlier studies (Popay et al., 2003; Thomas, 2016; Wacquant, 2007). There was often tension in these narratives: Māngere was home, 'the best', but also a place at times spoiled by others who unsettled their connections to place. A number of interviewees had spent all their life in Māngere and shared nostalgic recollections of when times were different but as the woman quoted talking about driving on the footpath said, she had also been young in the neighbourhood once and was forgiving of the 'improper' behaviours of youth. There were neighbourhood histories to draw on: uplifting stories of community people, relationships and events but also notorious incidents etched into the collective memory. Outsider representations of Māngere, at times tarnished by a 'blemish of place' (Pearce, 2012), were variously acknowledged and decried.

To again draw on Popay and colleagues' (2003) analysis, individuals had reached a 'negotiated settlement' with place (p. 67) and if travel behaviours are contingent on this 'settlement' some disruption of the relationship between people and place may be needed to prompt a significant change in active travel behaviour. To achieve such a disruption the study suggests interventions that integrate social and behavioural change with improvements to the material environment are needed and that the success of interventions will likely hinge on understanding and responding to the complexities of what sustains feelings of safety, comfort and ease in a neighbourhood.

The timing of the current analysis, approximately 6 months post-intervention completion, and the lack of clear patterns across the findings indicate the value of longitudinal research to track change over time in a broad set of active travel related social, behavioural and environmental measures and the importance of a mixed methods approach. Subsequent waves of data collection will establish whether or not this early data collection captured perceptual change as it was unfolding. The study also highlights the tension researchers face as they select or craft survey items and attempt to balance refining items to resonate with local experience and reflect the specifics of an intervention as implemented, and adopting validated measurement instruments that facilitate replication and cross-country comparisons.

The streetscape intervention was designed to increase the safety, ease and accessibility of active travel, informed by self-explaining roads theory. Resistance to loss of parking was anticipated but not the casual illegality seen in the use of the new infrastructure. There are a range of explanations for this, including the limits of community engagement – not all residents can participate, inadequacy in the intensity and design of the intervention and that the intervention is a small island of unusual design in a sea of physical and social environments that reinforce the rights and privileges of car drivers (see for example Daggett, 2018). What is 'self-explaining' may also vary by social context. If so, temporary trials of new infrastructure may be useful to establish and adapt designs to local use.

Community events to activate and celebrate the new infrastructure have been held in Māngere and may over time help inscribe normative use and reinforce community pride and identity (Cozens and Love, 2015). In turn, positive media stories of these events may lift the area's reputation in the eyes of outsiders. However, we are mindful that the pervasive influence of structural inequalities can cast a long shadow over the wellbeing and health-related behaviours of people living in higher deprivation neighbourhoods like Māngere.

6. Conclusions

This mixed methods analysis of a unique suburban intervention study focused on the interplay between resident perceptions of the people, places and safety of their neighbourhood and their travel behaviours. While the mix of quantitative and qualitative results suggest some improvements in neighbourhood perceptions of both safety and security post the intervention, results were inconsistent across the data sources, and highlight the complex and recursive relationship between people and place perceptions and their likely influence on travel behaviours. Potential explanations for the equivocal findings include measurement methods, a legacy of neighbourhood social disease; entrenched expectations about car use and priority; and the data being collected early on in a longer term process of shifting norms. Future waves of follow up are planned, and these will assist in understanding these complex effects further.

Declaration of Competing Interest

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

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Supplementary materials

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