



# Social relationships, nature, and traffic: findings from a child-centred approach to measuring active school travel route perceptions

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## ABSTRACT

Globally rates of active school travel (AST) are in decline. New Zealand has one of the lowest rates of AST compared to other countries. To date much research investigating reasons for this decline and evaluations of interventions to increase the uptake of AST have occurred from an adult-centric perspective. This study takes a child-centred approach to elicit children's voice in understanding school travel perceptions and preferences. In total 1102 children aged 8–13 years from 19 schools across Auckland, New Zealand took part in a public participation GIS survey utilising both closed- and open-ended questions. The results indicate that regardless of active or passive travel mode, children are aware of the distance/time to school and enjoy the opportunity for social interactions. An evidence-based framework for understanding and measuring children's likes, dislikes, and key activities for their route to school is presented.

## ARTICLE HISTORY

Received 6 September 2018

Accepted 8 October 2019

## KEYWORDS

Active travel; active transport; passive travel; child voice; built environment

## Background

Physical activity plays a vital role in children's current and future health, development and wellbeing (World Health Organization 2011). Conversely, time spent sedentary (e.g. sitting, lying) has been shown to have detrimental effects on health independent of physical activity (Hamilton et al. 2008). In line with most industrialised countries, New Zealand children's physical activity levels are decreasing and sedentary time is increasing (Smith et al. 2018). Active school travel (AST, e.g. walking or cycling to school) is a convenient opportunity for many children to accumulate physical activity (Schoeppe et al. 2015; Oliver, Parker, et al. 2016) and can disproportionately but positively displace time spent sedentary in vehicles. For instance, a 10 min car journey may take up to an hour on foot (Chillón et al. 2011; Larouche et al. 2018). There is a noticeable difference between the time it takes to get to school on foot compared to in a vehicle. However, the long-term effects of routinely walking to school demonstrate positive health benefits compared to transportation by vehicle routinely. Improving levels of AST can yield numerous co-benefits, including reduced traffic congestion and associated carbon emissions (Delbosc and Currie 2013; Korkala, Hugg, and Jaakkola 2014). Despite such significant benefits, AST in New Zealand children is low following a substantial decline over recent decades (Ministry of Transport 2015; Smith et al. 2018).

This study draws from the socio-ecological model of health behaviour, a framework that encompasses the multiple layers of possible influences on AST (Sallis, Owen, and Fisher 2015). Aligning

with this model, the built environment, the natural environment, the social environment and safety are pertinent to understanding AST.

Distance to school is the most consistent associate of AST across country, age and socio-economic status (Schreiber et al. 2006; Rothman et al. 2018; Ikeda et al. 2018). Traffic exposure, street and path connectivity and presence of walking or cycling facilities are important factors associated with school travel mode (Pont et al. 2009; Chillón et al. 2011; Rothman et al. 2018). However, estimated variables from an adult-centric perspective on AST route may not be transferable (Ikeda, Mavoa, et al. 2018). Calls for increased sensitivity and specificity in understanding the environment-behaviour relationship have been made (Giles-Corti et al. 2005). Few studies have examined built environment features for the school route (Ikeda, Mavoa, et al. 2018), with most estimating values for an arbitrarily defined neighbourhood and linking these with AST. Estimated routes (e.g. using geographic information systems (GIS)) can differ significantly in terms of spatial overlap and environmental characteristics from actual routes travelled (Ikeda, Mavoa, et al. 2018).

The natural environment (e.g. topography, weather and flora and fauna) has also been associated with children's activity and may be linked with AST. Children who live in rural, suburban and inner cities have been shown to engage meaningfully with nature in their surroundings (Freeman et al. 2016). Indeed 'special trees' have been noted as neighbourhood places of importance in previous research with children in New Zealand (Freeman et al. 2016). Weather, particularly extremes in weather (i.e. rain, heat and snow), is a prominent theme to emerge from qualitative research with children on their interaction and engagement with their everyday environments (Ross 2007; Chaudhury et al. 2019). Likewise, geographic features such as hilly and undulating terrain can influence walking and cycling levels (Baslington 2008). Natural environments like beaches and parks are commonly reported by children across the Pacific region as places of importance within their neighbourhoods (Freeman, Lingam, and Burnett 2015). Natural environments are often places of restoration for children (Korpela, Kyttä, and Hartig 2002; Wells and Evans 2003), and provide opportunities for physical activity, play, and social interaction (Carr and Luken 2014).

The social environment is also important for understanding school travel mode. AST has consistently been shown to be associated with neighbourhood social interaction. Greater and more frequent community connections avail more 'eyes' to provide social surveillance for children who are engaging in AST (Egli et al. 2018). A consistent inverse relationship between household income, car ownership and AST has been reported (Pont et al. 2009; Chauhan et al. 2019; Rothman et al. 2018). The most likely reasons for this include 'trip chaining' and increased distance from school in higher socio-economic groups who may select schools based on reputation rather than locality (Fyhri et al. 2011; Mandic et al. 2017), and to ease drop off and pick up for working parents (Witten et al. 2013; Black, Kolesnikova, and Taylor 2014). It is also important to note that there are many cultural differences and social norms relating to AST and indeed this is reflected in vastly different rates of AST across countries, for example Switzerland and Columbia have AST rates around 70% (Fyhri et al. 2011), whereas New Zealand has one of the lowest rates of ATS internationally, with 29% of children aged 5–17 years walking and 2–3% cycling to school (Ministry of Transport 2015).

Parents act as gatekeepers to children's AST and parents perceived neighbourhood safety including traffic safety and social-surveillance are major influences on parental licence for AST (Oliver et al. 2014; Mah et al. 2017; Egli et al. 2018). Concern about traffic safety is the most commonly reported perceived barrier to AST by parents (Lu et al. 2014). Parents appear to be acutely aware of the increase in the number of cars on the road compared to when they were children (Witten et al. 2013). Less cited and not strongly associated with rates of AST, but an underlying consideration, is that of 'stranger danger' and lack of community surveillance (D'Haese et al. 2011). Some research shows that parents report that their children prefer to be driven to school and this influences travel mode decisions (Lu et al. 2014). However, these studies were conducted via in-depth interviews and surveys with parents. While the opinions, concerns and fears held by parents are well known, much less is known about children's perceptions as reported by children.

Altogether, this body of evidence demonstrates the complexity of understanding factors that may influence children's AST from a researcher and parent perspective. Yet, little is known from the child's perspective. Individual factors are also important components of school travel mode. Increasing age, male sex and non-Caucasian ethnicity are also associated with higher levels of AST, although the relationship with ethnicity is attenuated when controlling for socio-economic status (Lu et al. 2014; Rothman et al. 2018). Evidence suggests that self-efficacy for independent travel to school may play a role. Importantly, when asked, children indicate a preference for AST and can act as powerful advocates for their own health behaviours, playing a key role in decision-making around AST (Hinckson 2016). However, evidence is lacking on factors that may encourage AST from a child's perspective.

Understanding children's viewpoints can add context and value when developing environments conducive to their health and well-being which may not be captured by adult-centric methods. Child-centred approaches such as photovoice (Fusco et al. 2012; Carroll et al. 2015), affinity group interviews and go-along interviews have successfully been employed to identify unique insights into relationships between the built environment and children's health behaviours (Oliver et al. 2011). The main limitation of these methods is that they are resource-intensive, allowing capture of information from small sample sizes only. Qualitative GIS and participatory mapping are methods that have a long history of being successfully used with children (Veale 2005; Brown et al. 2017; Wilson et al. 2019).

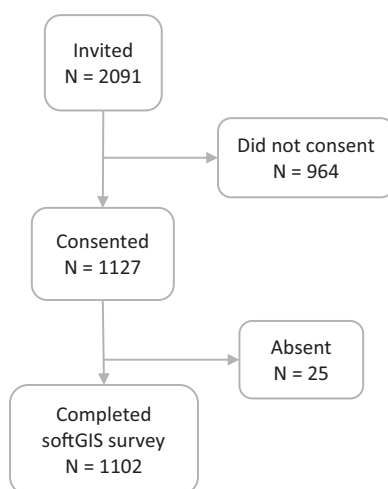
A recently developed tool, public participation GIS (PPGIS) ([www.maptionnaire.com](http://www.maptionnaire.com)) can address some of these limitations through internet-based surveys which allow for place-based studies of human experiences and everyday behaviour, capturing both qualitative and quantitative data with large sample sizes (Kahila and Kyttä 2009; Kyttä et al. 2013). The PPGIS methodology has been successfully employed in a range of surveys with over 1800 children and young people internationally (Kyttä, Broberg, and Kahila 2012). Recently, PPGIS was used to map the urban experiences of over 1300 children from Finland and Japan (Kyttä et al. 2018). The authors call for research that considers the diverse environmental experiences and preferences of children. PPGIS is child-friendly, scalable, and able to capture qualitative and quantitative experiential information from children's perspectives.

This research takes a child-centred approach to undertaking research with children (Stafford 2017). It acknowledges that children and childhood are not homogenous (Beazley et al. 2009) and that childhood is more than a physiological and psychological period of development (Prout and James 2003). In this research, children are seen as active, social beings who shape the structures and processes around them (Morrow 2008). Thus, it is important that in addition to the predominantly quantitative research on motivations for, barriers to and facilitators of AST that the child's voice is also heard. The aim of this research was to understand preferences and perceptions about the route to school with a large group of children living in Auckland, New Zealand, from their own perspective, using PPGIS.

## Methods

### Participants

This study reports results from 1102 children aged 8–13 years from eight intermediate schools (middle/junior high, children from school years 7–8, hereafter 'older children') and nine primary schools (elementary schools, children from school years 5–6, hereafter 'younger children') in Auckland, New Zealand, participating in the Neighbourhoods for Active Kids Study (NfAK). The aim of NfAK was to determine how neighbourhood built environments are associated with independent mobility, AST, physical activity, body size, and neighbourhood experiences of children. Only methods that pertain to this paper are presented; full details of the study design and methods are described in detail elsewhere (Oliver, McPhee et al. 2016). Ethical approval to conduct the study



**Figure 1.** Flow of participants through the Neighbourhoods for Active Kids study.

was provided by the host institution ethics committees (AUTEC, 14/263, 3 September 2014; MUHECN 3 September 2014; UAHPEC 9 September 2014).

Children were recruited through intermediate (middle/junior high) schools (7–8 years, approximate ages 11–12 years) and a contributing primary school (including children from 5 to 6 years only, ages 9–10 years) across eight neighbourhoods. Neighbourhoods were selected through the utilisation of a matrix encompassing neighbourhood-level socioeconomic, walkability and destination accessibility features to identify areas for recruitment. School decile was used as a proxy for area level socioeconomic status (Ministry of Education 2016). Parents provided informed consent prior to the data collection session and before data collection commenced children provided verbal assent. Children were taken through the PPGIS programme with one research assistant allocated per child. The time taken to complete the PPGIS survey varied from approximately 15 minutes to 35 minutes. Flow of participants through the NfAK study can be seen in Figure 1.

### Study location

Auckland is the largest city in New Zealand with a population of approximately 1.5 million people; approximately a third of all New Zealanders reside in Auckland (Statistics New Zealand 2013). Auckland is a city with large numbers of immigrants from the Pacific, Asia and Australia. It is a city of contrasts, both in land use type and wealth. High density city living sits alongside sprawling housing developments and traditional beachside settlements, fringed by harbours, subtropical rainforests and farm land. The results from the most recent census show that Auckland contains the richest areas in New Zealand, and the poorest, often juxtaposed in close geographic proximity to each other (Exeter et al. 2018).

### Procedure

Data were collected from February 2015 to September 2016, in 19 schools across the Auckland region. Trained researchers visited participating schools during school hours and, following standard operating procedures, provided child participants one-on-one assistance to complete an online interactive mapping survey (PPGIS). Pilot testing of the survey was conducted prior to data collection, to ensure acceptability and utility of the PPGIS method with young New Zealand children (Oliver, McPhee, et al. 2016). The data presented here were gathered from closed- and open-ended questions within the PPGIS survey. The closed-ended questions were about their usual modes of travel to school (including

single or multiple modes within the travel). Children were identified as participating in active school travel if any active mode(s) (e.g. walk, bike, scooter, skateboard) were involved within the travel. Passive travel was determined to be either car or public transport only reported within the travel. Children were not given specific guidelines on what constituted each travel mode. In line with child-centred research methods children were respected as being able to answer these questions and determine their own 'usual mode of travel' themselves (Jones 2008). Three open-ended questions were asked: (1) What do you like about your usual route to school? (2) What do you dislike about your usual route to school? and (3) What do you like to do on your usual route to school? Children answered these questions independently and were not probed for clarification or expansion of ideas (Noonan et al. 2016; Kanagasabai et al. 2018), when children asked for assistance with entering open-ended responses into the PPGIS programme, researchers typed exactly what was said by the child. Information on participants' school year, sex, and ethnicity was provided by the school.

## Analysis

PPGIS survey responses were downloaded from [www.maptionnaire.com](http://www.maptionnaire.com) and combined with demographic datasets in Microsoft Excel. These datasets were then uploaded into SPSS version 25 for analysis. Information on the mapping component of the PPGIS survey from Neighbourhoods for Active Kids is described elsewhere (Ikeda, Mavoa et al. 2018; Egli et al. 2018 and presented here are the responses to the three open-ended questions.

Descriptive information for demographic characteristics, usual travel mode, and count of comments made was calculated in SPSS. Responses to the three open-ended questions were imported into NVivo 11 Pro (QSR International Pty Ltd. Version 11) for analysis. The responses were concise, list-type text, which typically ranged from single words to short phrases that contained single or multiple themes. These data represent child 'top of mind' perspectives of their route to school, in terms of what they like, dislike and what they like to do while travelling to school. The nature of short open-ended responses allows broad insights from a large sample of children not captured in closed-ended questions (Roberts et al. 2014).

Content analysis focussed on the content and contextual meaning of each response statement, either explicit or inferred. Content analysis included deductive (i.e. pre-determined themes based on the previous literature) and inductive (i.e. data-driven) methods to identify themes within the data. Broad pre-determined top-level themes were developed based on features of neighbourhoods previously reported to be associated with children's AST ('Built Environment', 'Natural Environment', 'Social Environment', and 'Safety'). Sub-themes were added based on concepts emerging from the text. Where more than one concept was expressed in a single response, each concept was coded separately. For example, one response to the question 'What do you like about your route to school?' was, 'It's easy to remember, and I can meet friends on the way to school'. This response was broken down into two separate statements: (a) 'It's easy to remember', and (b) 'I can meet friends on the way to school'. The authors independently and collaboratively conducted the process of examination, articulation, re-interpretation, omission, and addition or reformulation of the themes and subthemes. Once coding was complete, a printout of all statements within each sub-theme was reviewed to confirm their correct categorisation. Interpretation of coded themes was conducted separately for each question. Overall counts of statements were used only to identify the most popular themes for the sample, and for each age, sex and travel mode group.

## Results

### Participants

Participant flow through the study is shown in Figure 1. Demographic and usual travel mode information is presented in Table 1. The final sample was ethnically representative of the New Zealand

population (13% Māori, 15% Pacific, 13% Asian) and 49% were male (Auckland Council 2014). Approximately half of the participants were from a primary school (51.4%), with the remainder attending intermediate school. Overall, 852 (77.3%) reported what they like about their route to school, 851 (77.2%) reported what they like to do on their route to school, and 749 (68.0%) reported their dislikes.

### Coding Structure

Four top-level themes were developed based on literature: 'Built Environment', 'Natural Environment', 'Social Environment' and 'Safety'. Two additional top-level themes, 'Activities' and 'Travel to School', arose through the data. Sub-themes were added to describe the meaning of responses. Definitions of these themes can be seen in Table 2. A framework of the themes developed through deductive and inductive methods is presented in Figure 2.

Altogether, 3492 items emerged from the three short-answer questions. Of these, 1174 (34%) items were coded as features children liked about their route to school, 821 (24%) items were coded about what children dislike, and 1497 (43%) items were coded as things children like to do on their route to school.

#### Built environment

The most mentioned feature of the children's route to school was the time/distance travelled. Most children liked the time/distance to school with 314 (76%) positive compared with 97 (24%) negative related sentiments. Boys and girls, and younger and older school children used similar language to express concurrent views. The quotes given below display this information as: sex (male (m) or female (f)), travel mode (bike, scooter, skate, walk, car, public) and age (older or younger) e.g. a younger girl who walks to school is reported as f\_walk\_younger. Whether the children in this study reported liking short or long journeys depended on the mode of transport, with those using AST expressing that they like that their journey is short and quick. AST was often recognised as being the fastest way to get to school. To some extent this was facilitated by being able to use routes other than the street network:

"its fast and it's the closest way to get to school" m\_walk\_older

"it's faster than taking the way through my street" m\_bike\_younger

Most children also liked that driving made their journey fast:

"I like that it is quick in a car" f\_car\_younger

Others liked that it took a longer time because it gives them time to play or talk with friends:

**Table 2.** Top level themes and their descriptions.

Top Level Theme:	Description
Built Environment	Built environments are the living spaces created and modified by people, for example homes, workplaces, services and roads
Natural Environment	Natural environments are any public space that contains flora and fauna, for example parks, recreation areas, forests and blue space
Social Environment	Social environments are places that facilitate or allow for social interactions to occur, common social environments for children include playgrounds
Safety	Safety includes all real and/or perceived threat to the physical, emotional or mental wellbeing of children and those in their social networks, for example, traffic safety from crossing busy roads and personal safety from bullies
Activities	Activities includes to all actions undertaken during the route to school, for example riding bikes and listening to music
Travel to School	Qualities of travel to school are those that impact on the time, duration or value placed on an aspect of the school route, such as ease of and the duration of travel

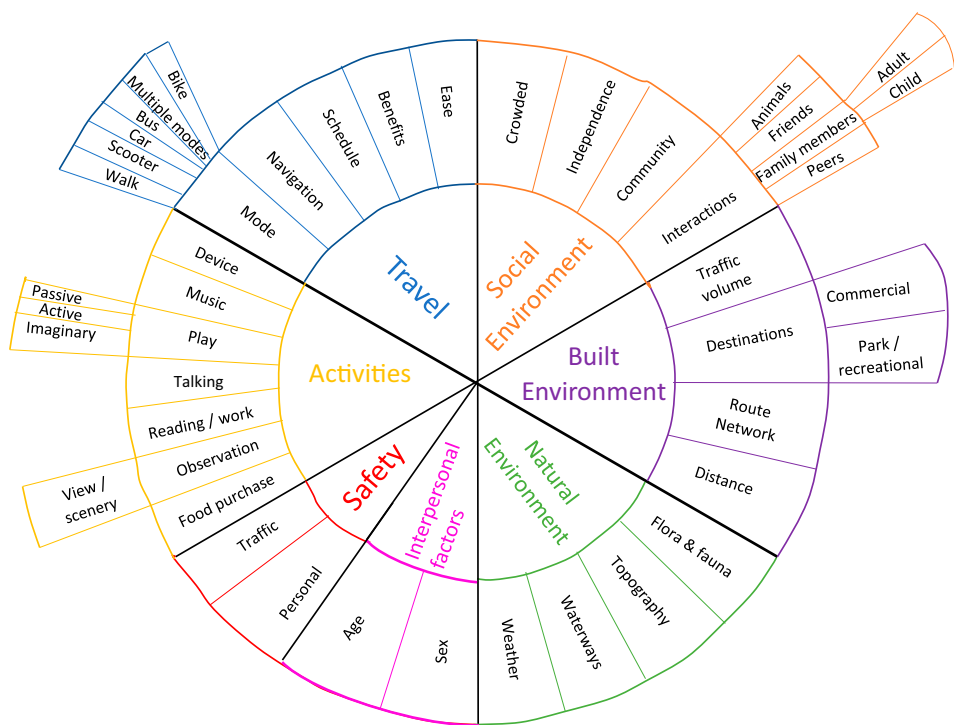


Figure 2. Framework for children's travel to school.

"pretty long that's why I like it" m\_car\_older

"its far so it gives me time to talk to my friends" m\_public\_older

With regards to the street network, children who walked indicated that they liked shortcuts and that they didn't have to cross many roads:

"I get to go through the park" m\_walk\_younger

"I don't have to cross any big roads" f\_walk\_older

Some children whom were driven were aware of whether the drive was convoluted or straight and how long it might take when it was clear compared to during the school rush.

Boys from primary schools like being able to stop at shops on their route to or from school:

"go to the shops and buy food with my friends" m\_walk\_older

The most commonly cited factor disliked by children was traffic exposure. There were no differences between boys and girls, but a greater number of younger (primary school-aged) children commented on traffic than older (intermediate school-aged) children. Those that were driven to school did not like that traffic on the roads made their commute longer, whereas those who walked mentioned how cars made it difficult to cross the road. 35 (3%) children specifically mentioned not liking having to cross roads:

"we have to cross the roads a lot" f\_walk\_older

"I also don't like when cars are speeding past me when i and other kids are trying to cross the road." f\_walk\_older

Three times as many younger children than older children, and more girls than boys (51; 59% vs. 35; 41%) disliked that their car journey to school was too long. This was more common if they got stuck



in traffic. On the other hand, a few older students indicated that they would prefer a longer walking route:

"i don't like that it's not long enough because i'd like to run more or fit in more activity" m\_car\_younger

### *Social environment*

With regards to the social environment, there were 124 (15% of the 852 total) and 362 (43% of the 851 total) answers to the '*what do you like?*' and '*what do you like to do?*' questions, respectively. It was clear that children saw their journey to school as a good opportunity to play and talk with friends and family. Who these interactions were with depended on the mode of transport, with children who walk and take the bus enjoying interacting with their friends, whereas those who are driven appreciating time with family members:

"i like that we get to pick up up my friend so we can walk together" f\_walk\_older

"I like to sit down and talk to my mum in the car" f\_car\_younger

The volume of responses indicated that journeying with friends was most important to younger boys, and that talking with parents and siblings was most enjoyed by older girls. The appreciation of this chance to socialise was further highlighted by those who did not get this opportunity:

"i don't like that i can't walk to school with my friends" m\_walk\_younger

"you dont get to stop and say hi to friends" f\_car\_younger

Using the bus meant that they could catch up with those they wouldn't otherwise see during the day:

"i like that i get to see my friends on the bus that aren't in my class" m\_public\_younger

There were few dislikes regarding interactions with the social environment (363;18% references vs. a combined 1691;82% for like and like to do). Those that were mentioned were almost exclusively from younger children who used the bus and found it crowded and noisy:

"i don't like that on the bus there's too much noise and it gets full fast because there are heaps of people getting on the bus" m\_public\_older

When comparing interactions with friends to those with parents or siblings, there were more negative comments regarding family members than friends:

"That my sister always annoys me on the way" m\_car\_younger

Interestingly, the majority of these (20/28; 71%) were responses of children whom travelled by car:

"when we flight with my brother in the car" m\_car\_older

### *Natural environment*

Environmental factors were important to both younger and older children who commented that they did not like noise or air pollution:

"Don't like pollution from cars" m\_walk\_older

"when cars beep the horn ... ..it hurts my ears" m\_walk\_younger

Children enjoyed walking though natural, green spaces and did not like it when they encountered litter, particularly glass:

"I like looking at the view and being relaxed" f\_walk\_older

"Lots of glass and cracks in the pavement" m\_walk\_older



There were 95 mentions of hills of which 53 (56%) were negative. Most comments (60%) were made by primary school boys who walked. Intuitively, children liked walking down hills in one direction, but not up in the other:

“there are a lot of downhills and also flat. But it’s hard to go back because it’s uphill” f\_scooter\_older

Some children (3%) mentioned they disliked the extremes of the weather conditions in Auckland, New Zealand:

“no shelter gets hot when its sunny” f\_car\_older

“sometimes when it’s rainy I don’t like” f\_car\_older

### Safety

There were only a small number of references to safety: 72 (52%) positives and 66 (48%) negatives. Most were general comments describing the route as safe although a few went into more detail about how they like being able to avoid road crossings or traffic and being surrounded by people:

“its not hard to cross the road and I dont get scared of being hit by a car” m\_scooter\_older

“i know a lot of people so i feel really safe because i leave early in the morning” f\_walk\_older

On the other hand, where cars and busy roads were an issue, children were perceptive to the quality of driving they encountered:

“sometimes people drive very crazy” f\_car\_younger

“these cars rush out of the drive way and we are pretty close to them making them dangerous” m\_car\_younger

Notably, the most frequently mentioned dislike relating to safety was primary school boys’ aversion to dogs:

“i dislike when my friends dog is outside and i need to wait until it goes inside so i can walk past to keep walking to school” m\_walk\_younger

### Activities

In line with what children said they liked about the social environment, the most commonly reported activity was talking with friends and family:

“I also like to talk to my mum or my dad (depending on who drops me off) about everything” f\_car\_older

Time spent travelling to school was also used for play. Children who used AST more often reported that their play was active, whereas children who were driven played either video (using mobile phones) or imagination games:

“on my bike and my scooter i like to do jumps” m\_bike\_younger

“Pretend that I am running on the powerlines” m\_car\_younger

Ball games were particularly popular, with children bouncing, kicking or passing basketballs, footballs, handballs and rugby balls. Some children were able to use the school facilities before travelling home:

“sometimes I play playground before I leave” m\_walk\_younger

Many children who are driven to school, and some that walk, liked to listen or sing to music either on the radio or on their mobile phones:

“I like to listen to music in the car” f\_car\_younger

"I sometimes sing while walking" f\_walk\_younger

Interestingly, of the 39 mentions of electronic devices, only nine (23%) of them were by children who walked. Use of devices by children using both active and passive travel was the same; either to listening to music or playing games.

Children who travelled to school by bus or car also frequently mentioned that they liked to look out the window and take in what was going on around them:

"i like to look at everything (the view outside your window)" f\_car\_younger

"just sit and watch outside" f\_car\_older

Comments from children who walked were more contemplative compared to children taking the time to reflect on school, take in their surroundings or think more generally:

"i like thinking about my day" f\_walk\_younger

"Looking around to see what is coming and discover something" m\_walk\_older

### Travel to school

As data were being coded, it became clear that children simply enjoyed the action of walking, and preferred walking to being driven:

"its a nice walk to school" m\_walk\_younger

"i like that i don't have to go in a car" m\_bike\_younger

A small number of children stated that they did not like that they were '*not allowed to walk*' m\_car\_older. Few children said that they liked being in the car and those that did enjoyed it because '*it's quicker than just walking*' m\_car\_younger

Some children in this study reported being conscious of the benefits to their health and well-being that they experience by walking:

"i like that it's fun and it helps me stay fit" m\_walk\_younger

"i find it quite relaxing" m\_walk\_older

Reasons children gave for not liking to walk, referred to the built and natural environments with regards to the distance and hills, respectively, as opposed to walking itself.

Overall, most older children either liked using the bus because they got to spend time with friends or disliked it because it was busy and crowded. Only a few children thought that using the bus was enjoyable in itself:

"you can catch the bus which is fun" f\_public\_older

Furthermore, numerous children noted that the bus was often unreliable:

"sometimes the bus is late or full" m\_public\_older

"it sometimes doesnt come" m\_public\_older

Similarly, attitudes towards being driven in the car were largely determined by external factors e.g. traffic although one girl said that she likes '*that i am in the car*' f\_car\_older, and some children '*sleep because it's a long drive*' m\_public\_older.

### Discussion

The aim of this research was to understand preferences and perceptions about the route to school of a large group of New Zealand children, from their own perspective, using PPGIS. This paper presents

an evidence-based framework for understanding and measuring children's likes, dislikes, and key activities for their route to school. Perspectives of over 1100 children living in Auckland, New Zealand and were aggregated and contextualised within extant literature. According to children, the most commonly mentioned feature of a route was its time or distance, with most children liking that their school was close to home. The social interactions enjoyed by children on either their active or passive travel to school is an important finding for parents, schools, public health practitioners and town/city planners alike. This time spent with friends and family was perhaps most likely to be spent talking but, could also be used as an opportunity to play. This play was often active when children were not confined to a vehicle. When natural environments such as bush or parks were mentioned, attitudes were unanimously positive and appeared to be associated with safer routes where fewer cars would be encountered. Findings provide child-centred evidence that can help inform future interventions to increase AST.

School policies to reduce 'door to door' chauffeuring by promoting mixed modes of travel (i.e. walk plus car) would increase rates of active travel among children for whom car travel is a necessity. Specific interventions could include moving the designated drop off and pick up area away from the front of school gates to allow children an opportunity to walk one or two blocks until their caregiver picks them up. This would increase mix modes of travel and reduce traffic around school gates. Additionally, locating schools within residential areas would reduce the distance to school for children attending their local school. Locating schools on the outside of suburbs decreases the likelihood of children using active modes of travel to/from school (Giles-Corti et al. 2011).

For children who actively travel to school, getting to know places and people in their neighbourhoods can be associated with important child development milestones specifically spatial knowledge, safety perceptions and social interactions (Villanueva et al. 2016; Waygood et al. 2017). Our findings indicated that during the school travel route, children had different and more complex ways in which they used their time than previously described. Beyond only walking, only cycling or only being driven, our child-centred approach gave children the opportunity to voice that they often combined activities, for example '*biking and exploring new tracks with friends*', '*sitting in the car and talking to mum about my day*'.

These child voices may echo those of their parents (Jennings and Niemi 1968), however, it cannot be ignored that children in this study are acutely aware of driving quality, congestion, noise and particulate matter pollution. These findings align with research conducted among European children, who also described traffic and noise pollution as built environment risks to health (Stansfeld et al. 2005; Pluhar et al. 2009). Such observations reinforce issues reported by adults and should be considered when developing policies to promote AST because it is likely that these barriers will influence future behaviour when children's mobility is fully independent.

While research indicates that contemporary parents spend as much or more time with children as in the past (Bianchi 2000; Sandberg and Hofferth 2001; Bianchi, Robinson, and Milke 2006) evidence also suggests parents perceive challenges in getting enough time with their children while they juggle family life with paid work and other obligations (Milkie et al. 2004). Trip-chaining has emerged as one way that parents manage school drop off and pick up with commuting to places of employment (Carver, Timperio, and Crawford 2013). While it may not seem 'front of mind' for parents, children in this study who were chauffeured to school reported that spending time with family members in the car, talking about their day, singing together, listening to music, or playing games were the things they most liked to do. Time-squeezed parents may not realise that time spent in the car is an important time to connect with children, but children in this study report that it is. Increasing awareness of this opportunity among parents could help mitigate parental perceptions of time scarcity and increase children's socialisation and everyday connections to parents and caregivers.

It is likely that, overall, children make the best of their journey to school regardless of mode of travel. However, given that the majority of negative comments made referred to busy roads and crowded buses, it seems reasonable to infer that if children are able to walk a short distance with company, on dedicated paths through green spaces, they would prefer an active over a passive

commute (Hinckson 2016). This has important implications for town/city planning policies. Based on this research, creating sidewalks away from busy roads and through natural spaces may create 'shorter distances' for active school travellers (D'Haese et al. 2011) as well as contribute to additional benefits to health and well-being including, but not limited to, those from physical activity, social interactions, development opportunities and restorative connections with nature (Carver et al. 2010; Chaudhury et al. 2019).

### ***Strengths and limitations***

This study was strengthened by a large and diverse sample size of over 1,100 children from a large, socioeconomically and culturally diverse city. The content analysis of open-ended survey questions using both inductive and deductive methods makes it comparable to previous research but also ensures that novel ideas and key concepts are not missed. One of the limitations of this study is that some of the context of the communication behind the responses may have been missed. This may have occurred due to the succinct nature of the PPGIS survey when compared to qualitative interview or focus group methods. This lack of further probing allowed for a larger sample size of children to be included in the research, however it also meant that detailed insights and/or confusing responses could not be clarified.

A strength of this study was the child-centred approach that taken. For example, no adult-centric guidelines were given to children regarding travel modes, thereby allowing children to decide and report on their usual travel mode themselves. This respected children's ability to answer questions about their own experiences (Jones 2008). A limitation of this approach meant that in the analysis of open-ended survey responses it was not possible to distinguish between a child who walked a long distance to school and one who walked a very short distance if the child did not state this themselves. It is known that distance to school and socio-economic status are significant correlates of AST in children and may influence their travel to school perceptions and preferences (Rothman et al. 2018; Ikeda et al. *In Press*) and this study is limited by not accounting for this in the analysis.

Future research opportunities exist to build upon this work using child-centred research methods. Focus groups could be conducted where children are asked to elaborate on the questions asked, including researcher prompting for detail and clarification. In these focus groups children could also be asked to provide their feedback into the framework developed and it could be adjusted as needed. Additional research opportunities exist for greater understanding of the importance of socialisation during the trip to/from school. For example, there are opportunities for qualitative research and co-design interventions to enhance socialisation and communication between parents and children during the route to/from school.

### ***Conclusion***

This study presents the results from a large sample of children aged 8–13 years, using a child-centred approach to understand the perceptions and preferences of children's routes to school. This everyday activity is important for physical activity accumulation, cognitive and proprioceptive development, socialisation and is an important opportunity for engaging in restorative experiences in nature. Overall, our results indicate children are primarily concerned with the time/distance of the route to school. Children who actively travel to school are aware of traffic safety and air pollution and prefer commuting with friends and/or family members. Children who travelled by public transport reported that buses were often overcrowded and/or unreliable but that they enjoyed spending the time with friends. Children who were chauffeured in cars reported time spent in the car with parents or caregivers was enjoyable because of the opportunity it afforded them to talk about their day and/or listen to music and sing together. To confer benefits to child health and well-being the results from this study support that sidewalks be located away from busy roads to allow travel through natural spaces, and that schools consider located pick up and drop off zones away from the front of school

gates in order to afford children the opportunity to walk and cycle. Additionally, interventions to increase parental awareness that time spent chauffeuring children in cars is important for socialisation and connection may help to alleviate parental concerns over time scarcity.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Funding

This study was supported by the Health Research Council of New Zealand (grant number 14/436). MS is supported by a Health Research Council of New Zealand Sir Charles Hercus Research Fellowship (grant number 17/013).

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