SOCIAL AND RECREATIONAL TRAVEL: THE DESTINATIONS, TRAVEL MODES AND CO_2 EMISSIONS OF NEW ZEALAND HOUSEHOLDS

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Abstract

Road transport has been a major contributor to New Zealand's increasing rate of CO_2 emissions over the past 15 years. New Zealand Travel Survey (NZTS) data show that 29% of the kilometres travelled by households are for social and recreational purposes. These trips are less amenable to the travel demand management strategies applied in work and school settings (such as increasing public transport, parking restrictions and travel plans) because they occur at all times of the day and all days of the week, and trips are taken to an unlimited number of destinations. To understand the characteristics of social and recreational travel, an analysis of the destinations of the 18,299 social and recreational trips recorded in the 2003−2006 NZTS was undertaken. Transport mode use for the most common trip destinations was compared and differences in trip patterns by gender, age, ethnicity and neighbourhood deprivation were examined. It was found that trips to visit family and friends and recreational trips to open spaces such as beaches, lakes and parks are the most common destination categories and those least often made on foot. The potential and limitations of virtual mobility and urban design to reduce CO_2 emissions from household social and recreational travel are discussed.

BACKGROUND

As evidence of global climate change and its anthropogenic basis accumulates (HM Treasury 2006, IPCC 2007), sources of New Zealand's greenhouse gas emissions have come under increasing scrutiny. Strategies to reduce emissions and the likely social implications of decarbonisation policies are also being examined (Boston 2007, Chapman and Boston 2007).

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In 2005 transport contributed 18% of New Zealand's CO_2-equivalent (CO_2-e) emissions and road transport represented 89% of these emissions (Ministry for the Environment 2007). A striking feature of transport emissions has been their rapid growth, with road transport emissions increasing 65% between 1990 and 2005. At this level road transport has been a major contributor to New Zealand's overall rate of emissions increase: 25% over the 15-year period (Ministry for the Environment 2007).

New Zealand has one of the highest rates of car ownership internationally, relatively low-density urban development and poor public transport infrastructure, all factors that have contributed to making us an auto-dependent nation. The same factors will make reducing CO_2 emissions from domestic travel particularly challenging. The trend in New Zealanders' transport behaviour has been one of increasing annual distances travelled by car (as both drivers and passengers) and decreasing distances using active transport modes (walking and cycling) (Ministry of Transport 2007a). A comparison of national annual estimates (NAEs) of the total distance driven by New Zealanders in the 1997/98 and 2003−06 household travel surveys indicates an increase of 16% between the surveys. In the same time period the population increased by 7%.

Social and recreational trips are a major component of domestic travel. Data from the 1997/98 survey showed that work-related trips (24%) and social and recreational trips (29%) made the highest contribution to the annual tally of kilometres travelled by vehicle drivers.[2] The significance of social and recreational travel is also underscored by data from the New Zealand Time Use Survey. An analysis of average minutes per day spent travelling for different purposes indicates that social and recreational travel consumes more time than work-related travel, for both men and women (Statistics New Zealand 2000). Women averaged 18 minutes a day travelling for social entertainment and sporting purposes and 12 minutes on labour-force participation. For men the equivalent times were 20 and 19 minutes, respectively.

Travel behaviour patterns, including mode use, differ depending on the purpose of a trip (Handy 1996). A comparison of mode use for work-related and social and recreational trips using 1997/98 survey data indicates that 72% of work-related trips were made as a vehicle driver compared to 38% of social and recreational trips; passenger trips comprised 7% of work-related trips and 35% of social and recreational trips; and walking trips were 15% of work and 22% of social and recreational trips (Land Transport Safety Authority 2000). Work-related trips are generally to a specific place, for a standard time period on set days of the week. Social and recreational trips are infinitely more flexible. They can occur at any time of the day, any day of the week and to an unlimited number of destinations.

Trips to work and school contribute to Monday to Friday peak-hour congestion so they have been extensively studied (Cairns et al. 2002). As a consequence, travel demand management (TDM) strategies, such as workplace and school travel plans, have been developed and are being implemented to ease congestion in larger urban areas (e.g. Auckland Regional Transport Authority 2007). By contrast, little attention has been given to understanding the characteristics of social and recreational travel. However, if a policy objective is to reduce CO_2 emissions, all kilometres travelled contribute to emissions irrespective of trip purpose.

[2] Percentages based on driver kilometres travelled excluding "home" trips and "work − main job" and "work − other job" combined.

Social and recreational travel is often described as "discretionary" whereas work-related and education-related trips are cast as "essential" (Frank et al. 2007, Loukopoulos et al. 2006). However, this categorisation is at odds with the importance placed on social inclusion within social policy in New Zealand and elsewhere (Miller 2007, Spoonley et al. 2005, Statistics New Zealand 2006). Mobility enables individuals and households to meet needs, aspirations and obligations that involve participation in activities that occur beyond the home. A change in transport behaviour that restricts participation in various life domains can contribute to social exclusion (Lucas 2004). This relationship has been observed in local studies of the impacts of poor access to transport on the lives of older people and people with disabilities (Davey 2004, Human Rights Commission 2005). Maintaining social ties and networks requires investments of time, and face-to-face contact can seldom be entirely replaced by virtual contact (Loukopoulos et al. 2006).

There are few situations where the effect of withdrawing access to private vehicles on the travel behaviour of the broader population can be observed. A rare example was the introduction of the carless day scheme to New Zealand in 1979 in the face of fuel price and supply fluctuations. The strategies people adopted to maintain their household activities varied by trip purpose (Elliot et al. 1980). Work-related trips on a nominated carless day, 84% of which were undertaken by car prior to the introduction of carless days, continued to be taken primarily by car (62%), either through the use of an exempt or second car or by car sharing. Mode shift occurred mainly through car pooling (5% to 19%) and to a lesser extent by increased bus (2% to 7%), motorbike (2% to 7%) and bicycle (7% to 12%) use. Shopping trips, car-based for 88% of trips prior to the carless day scheme, also continued to be primarily a car-based activity (55%), with mode shift favouring bicycle (3% to 15%) and walking (9% to 20%).

The response to social and recreational trips was somewhat different. Again car use for these trips was high before (88%) and after the introduction of carless days (66%) through the use of a second car or car pooling, but there was scant evidence of mode shift. Rather, 33% of trips were postponed (Elliot et al. 1980). The authors concluded that "The absence of non car modes suggests that personal [equivalent to NZTS social and recreational categories] trips are strongly linked to car use, and that carless days may be having a significant social impact" (p. 23). Mode shift was most common for regular trips (work) and to destinations that were geographically proximate (shopping).

An individual's travel patterns can be described as a series of trajectories in time and space (Miller 2007). Time is allocated to activities such as work, home, shopping and recreation, as well as time to move between these activities, as they generally take place at different geographic locations. Transport modes and information and communication technologies are then used to trade time for space as we schedule at a personal or household level how we can participate in various activities. Everyone has a finite time budget: an amount of time to allocate to a range of activities over a day or week or other prescribed time period (Huisman 2005). A person with access to a private vehicle can expand their activity space and respond to opportunities in narrower time windows than a person reliant on walking or public transport. Space−time activity analysis has highlighted differences in activity patterns and constraints on activities for people of different gender, age, socio-economic status and life stage (Kwan 1999). In sprawling, auto-dependent urban environments and rural areas where activity locations are widespread, limited access to a car can result in spatio-temporal exclusion: an inability to participate in activities, obtain resources or benefit from opportunities (Miller 2007). Land-use changes that increase the dwelling density and

decrease distances between work, home and play are strategies designed to shrink individual activity spaces and reduce travel demand.

Taken collectively, the social networks to which people belong interact with transport demand and transport systems. Axhausen (2006) has investigated the expanding geographies of social networks as a function of labour market specialisation and dispersion and residential mobility. Low-cost travel has been integrated into people's social lives, enabling what Axhausen (2006) describes as a strong preference for people to "maintain the existing social capital of their group or family", even where these networks are spatially dispersed (p. 162). In the New Zealand context many Māori, both urban and rural, regularly travel long distances to maintain whānau connections and links to marae.

Dravitzki et al. (2006) suggest that the impetus for the rapid uptake of car ownership in New Zealand may have been the opportunity a car provides for social and recreational travel. Although 87% of our population dwell in urban areas (Ministry for the Environment no date), high cultural value is placed on an outdoor lifestyle and on access to natural environments. A private vehicle is the only way to access many of these amenities. Dravitzki et al. (2006) also suggest that the outdoor nature of the recreational pastimes of many New Zealanders may influence the size of vehicles in the New Zealand fleet, with the occasional use for recreational purposes such as towing a boat or off-road trips determining the size of vehicle purchased.

This paper presents descriptive analyses of data collected by the NZTS 2003−06 on social and recreational trips (Ministry of Transport 2007b). Travel data were gathered from 12,700 people residing in 5,650 households between March 2003 and June 2006. All trips made by participants over a two-day period using all modes of transport were recorded. The types of trips categorised as social in the survey included all forms of entertainment at public and private venues, visits to private homes and non-private dwellings (e.g. hospitals) and preschool activities. Recreational activities were divided into active and passive participation in sporting activities, where the main purpose of the activity was exercise and travel to sporting or recreational activities (Land Transport New Zealand 2006). The Ministry of Transport provided data relating to the 18,299 social and recreational trips collected in the survey with linked spatial, demographic and temporal variables. A breakdown of the common destinations of New Zealanders' social and recreational travel has not been previously undertaken.

The research was undertaken as part of a project funded by the Foundation for Research, Science and Technology entitled Reduced CO_2 from Sustainable Household Travel. An aim of the programme is to understand the social impacts of reduced household fuel use. The paper describes the first stage of an investigation into the meaning of social and recreational travel to New Zealanders.

METHODS

Data and weightings from the NZTS 2003/06 were used to estimate the annual distance travelled by New Zealanders for social and recreational trips and the number of social and recreational trips taken in a year.[3] Text data recorded by survey interviewers to describe the

[3] The NZTS records "trip legs" as follows: a trip leg is a single segment of non-stop travel by a single mode. A reported stop or a change of mode ends a trip leg. For example, driving to a friend's place via a stop at the shops is two trip legs. In the data set on which this analysis is based, only the last trip leg in a change mode series is

destinations of participants' social and recreational trips were imported into Microsoft Access. Destination descriptions were examined by the authors (SM and KW) and 11 major categories of social and recreational destinations were identified. SQL queries were used to assign a category to each trip leg based on text in the destination description field. These queries allowed like destinations to be grouped (e.g. café, restaurant, bar, club) and the inclusion of trips where the destination was described by a common misspelling (e.g. friend, freind, frien, friends, firend etc.). Adequate information was available to categorise 81% of the 18,299 social and recreational trips in the NZTS 2003−06.

For the 11 social and recreational trip destination categories, trip leg and distance estimates were calculated in SAS 8.2 using the survey weighting. NAEs of trip legs are in millions of trips per year and estimates of distance in millions of kilometres per year. Differences in trip-leg numbers and distances for all social and recreational trips and major trip categories were investigated by day of the week, gender, age, ethnicity and neighbourhood deprivation. For reliable NAEs of trip-leg numbers and distances to be made, only cells with over 120 cases were included in an analysis (L. Povey, personal communication).

The sampling in the survey used a stratified cluster design. The sample was stratified by region of residence and by an urban−rural variable. Households were clustered within meshblocks. Variance estimation and statistical testing were done using SUDAAN 9.0 to account for the stratified cluster design of the survey. Due to the skewed[4] nature of the trip distance data, significance testing for distances travelled was done on the natural logarithm scale, and so we refer to the geometric mean rather than the arithmetic mean when describing differences. Most trip and distance figures in the tables are rounded to two significant figures. CO_2-e emissions were estimated using the fuel combustion emission factors (transport fuels) for 2006 (Ministry for the Environment 2008).

RESULTS

The distance travelled by New Zealanders for social and recreational trips was estimated as 10,500 (standard deviation [s.d.] 500) million kilometres annually and the estimated total number of social and recreational trips taken in a year as 1,050 million trips. The CO_2-e emitted by the kilometres travelled was estimated at 2,500 million kg.[5]

Table 1 lists the most common types of social and recreational destinations and national annual estimates (NAEs) of distance travelled for social and recreational trips to specific destinations.[6] Twenty-five per cent of the distance travelled was on trips to visit family or friends. Journeys to open spaces such as rivers, lakes and beaches made up a further 12% of the distances travelled. The three recreational categories (open spaces, sporting and non-sporting recreational activities) collectively accounted for approximately 25% of all estimated kilometres travelled for social and recreational purposes. A further 9% of distances travelled comprised trips to locations where food and drink are consumed, such as restaurants and bars.

considered as a possible social or recreational trip leg (any preceding ones will be coded as purpose or destination "Change Mode"). Trips and trip legs are used interchangeably when referring to NZTS data.

[4] Trip data are skewed due to a small proportion of trips being very-long-distance trips.

[5] The default value of .241 kg CO_2-e/km was used because engine size was unknown.

[6] Only categories with 120 or more trip legs allocated are listed. Known destinations with fewer than 120 recorded trip legs are included in the "other" category.

Table 1 Common Social and Recreational Destinations: National Annual Estimates of Distances Travelled

Trip leg destination	NAE in million km (s.d.)	Mean (arithmetic) trip distance in km (s.e.)	Mean (geometric) trip distance in km (s.e.)	Percentage of NAE by destination
Friends and family	26,000 (190)	11 (1)	6 (1)	25
Recreation – open spaces	1,200 (150)	15 (2)	8 (1)	12
Food and drink	900 (140)	14 (2)	7 (1)	9
Recreation − sporting activities	900 (160)	11 (2)	6 (1)	8
Recreation – non-sporting	500 (80)	11 (2)	6 (1)	5
Accommodation	500 (130)	50 (10)	13 (1)	5
Education facility-based activity	200 (40)	8 (1)	5 (1)	2
Window shopping[a]	200 (40)	11 (2)	6 (1)	2
Hospital – retirement village	200 (70)	15 (6)	6 (1)	2
Mobile destination[b]	80 (20)	10 (3)	7 (1)	1
Cinema	30 (10)	6 (1)	5 (1)	0
Other	1,200 (140)	13 (1)	6 (1)	12
Unknown	2,000 (230)	13 (1)	7 (1)	19

a. Only window shopping is categorised as a social trip.

b. Mobile destination captures recreational trips where the main purpose is to walk, cycle or drive.

The NZTS records the transport mode used for all trip legs, but distances travelled are not recorded for walking trip legs. NAEs of the number of social and recreational trips made using different modes in the 2003−06 survey indicate that 45% of trips were undertaken as a vehicle driver and 32% as a car passenger, 19% by foot and 2% by bicycle. Trip numbers are adequate for reliable estimates to be made for driver, passenger and walking modes only for the six social and recreational destination categories listed in Table 2.

Table 2 Common Social and Recreational Trips: National Annual Estimates of Number of Trips to Destinations and to Destinations by Mode

Trip leg destination	NAE of trip numbers (millions) (s.d.)	Percentage of social and recreational trips, by destination category (s.e.)	Percentage of trips, by mode, for destination categories		
			Driver	Passenger	Walk
Friends and family	280 (15)	27 (1)	51	35	11
Recreation – open spaces	110 (10)	10 (1)	38	34	23
Food and drink	90 (10)	8 (1)	37	35	25
Recreation − sporting activities	80 (5)	8 (0.4)	53	33	9
Recreation – non-sporting	50 (5)	5 (0.4)	46	36	14
Education facility-based activity	40 (3)	4 (0.3)	39	38	20

As indicated in Table 2, 27% of all social and recreational trips were visits to friends and family, and of these, 86% of trips were made by vehicle (51% by a driver, 35% by a passenger) and 11% were walking trips. Although driving is the most common travel mode for all social and recreational destinations, there was variation in the modal breakdown for different destinations. A higher percentage of recreational trip legs to open spaces and social trips to eating and drinking venues were made on foot than trips to sporting activities and visits to friends and family.

Table 3 National Annual Estimates of Social and Recreational Travel (Trip Number and Distances), by Day of Week

Day of week	NAE of trip leg numbers (million) (s.d.)	Percentage of trips (s.e.)	NAE of distance of trip legs, in million km (s.d.)	Percentage of distance	Mean (geometric) distance (s.e.)
Sunday	200 (12)	19 (1)	2,500 (280)	24	7(1)
Monday	120 (8)	11 (1)	1,000 (160)	10	6(1)
Tuesday	120 (9)	11 (1)	800 (100)	8	6(1)
Wednesday	130 (8)	12 (1)	1,000 (120)	10	5(1)
Thursday	130 (8)	13 (1)	1,400 (150)	13	7(1)
Friday	140 (8)	13 (1)	1,400(140)	13	6(1)
Saturday	220 (15)	21 (1)	2,400 (220)	23	7(1)

Not surprisingly, both distances travelled and numbers of social and recreational trip legs vary by day of the week, with more trip legs and longer distances being travelled on the weekend. Forty per cent of social and recreational trips and 47% of the distance travelled occurred on the weekend. The mean (geometric) distance travelled on Sundays is significantly higher than on all other days of the week (Table 3). In terms of specific destinations, numbers of trip legs and distances travelled were higher on Sundays for visits to family and friends and open spaces compared to most other days of the week, but the differences were not all statistically significant. Similarly, more trips were made to eating and drinking venues on Fridays and Saturdays than on other days of the week, but again not all pair-wise differences between these and other days of the week were statistically significant.

Table 4 National Annual Estimates of Social and Recreational Travel (Trip Numbers and Distances), by Gender

Gender	NAE of trip leg numbers, million (s.d.)	NAE distance, million km (s.d.)	Mean (arithmetic) trip leg distance, km (s.e.)	Mean (geometric) trip leg distance, km (s.e.)
Female	550 (18)	5,300 (270)	12 (1)	6 (1)
Male	500 (18)	5,300 (290)	13 (1)	7(1)

Men and women travel similar distances, but NAEs indicate that women make approximately 10% more social and recreational trip legs than men, although the trip-leg mean distance is shorter (Table 4). Key differences in the travel patterns of men and women relate to trip destinations. The destination for 29% of women's trips was family or friends, compared to 25% for men (t-stat = 3.57, p-value = 0.0006). A higher percentage of men's trips than women's were to recreational destinations. Open-spaces trips accounted for 11% of men's trips compared to 9% of women's trips, and sporting activities comprised 9% of men's trips and 7% of women's trips (t-stat = 2.97, p-value = 0.0057; and t-stat = 3.46, p-value = 0.0006, respectively). The mean (geometric) trip distance for men was greater than for women (t-stat = 3.07, p-value = 0.0024).

Table 5 National Annual Estimates of Social and Recreational Travel (Trip-leg Numbers), by Age

Trip-leg destination	Percentage of national annual estimates of trip legs, by age in years						
Friends and family	**0−14**	**15−24**	**25-−4**	**35−44**	**45−54**	**55−64**	**65 and over**
Recreation – open spaces	30	38	27	26	23	20	19
Food and drink	13	7	9	13	11	11	8
Recreation - sporting activities	4	9	11	8	9	10	7
Recreation – non-sporting	10	8	8	7	7	5	7
Education facility-based activity	5	3	4	5	6	6	8
Friends and family	8	3	3	3	2	2	2

NAEs of trip-leg numbers could be calculated for seven age groups for six social and recreational destinations after taking account of the data per cell requirements for analysis, as noted above. Table 5 reports on the percentage of all social and recreational trips taken by a specific age group to six destinations. Standard errors of the percentages vary from around 1% to around 5%. In pair-wise comparisons between destinations by age group, a higher percentage of trips taken were to educational facilities and sporting activities by 0−14-year-olds and fewer trips to eating and drinking venues compared to all other age groups, and 15−24-years-olds made significantly more trips to visit family and friends than all other age groups.

Mean (geometric) trip-leg distance of social and recreational trips varied by ethnic group, with Pacific people travelling the shortest mean distance (6 km) and people of Asian ethnicities the furthest (8 km). However, only the Asian mean (geometric) trip distance was significantly different from other ethnic groups, being significantly higher than for Europeans ($p = 0.015$), Māori ($p = 0.033$) and Pacific people ($p = 0.0161$).

The relationship between the deprivation level of the meshblock in which survey respondents lived, based on the New Zealand Deprivation Index 2006 (Salmond et al. 2007), and the mean (geometric) trip-leg distance travelled were also examined. Mean (geometric) distance of social and recreational trip legs increased as deprivation level decreased. The mean (geometric) distance travelled by those in the lowest deprivation quintile (7 km) was significantly higher than the mean distance of 6 km travelled by those in the highest deprivation quintile ($p = 0.032$).

DISCUSSION

Social and recreational travel makes up a large proportion of the distance travelled by New Zealand households and a correspondingly high proportion of domestic CO_2-e emissions. It is also likely that the NAEs reported above for social and recreational distances travelled are an

underestimate − a consequence of the convention used to code trip-leg purpose in the NZTS. For example, a holiday trip from Auckland to Rotorua with a stop en route for food and petrol would be recorded as two trip legs, but only the final trip leg would be recorded as social or recreational in purpose. The earlier trip leg would be recorded as purpose "shopping", even though the final social destination could not be reached without the first trip leg in the chain.

Visits to family and friends account for a quarter of all kilometres travelled, and recreational trips to sporting venues and beaches, lakes and other open spaces account for a further fifth of all social and recreational trips. Such trips are quintessential aspects of the New Zealand way of life and are important to health and wellbeing. They will not be relinquished easily in the face of rising fuel costs or in response to policies designed to reduce emissions.

The TDM strategies used to counter private vehicle use for the trip to work − such as improving public transport options, parking restrictions, workplace travel plans and congestion charging − have limited potential to affect social and recreational trips. These trips lack the regularity of timing, people volumes or common destinations that underpin the rationale for the success of TDM strategies. Although it may be theoretically possible in urban areas to replace car-based social or recreational trips with a combination of walking, cycling and public transport, the time involved in getting to a destination may make the trip unattractive, or even unfeasible. Time costs largely determine transport choices (Strazdins and Loughrey 2007). Public transport services are more intermittent on weekends when social and recreational trips are more common, a factor that makes trip planning more critical and the time penalty of missing a connection even higher for weekend than weekday trips.

The potential to curb the CO_2 emissions associated with social and recreational trips by adapting travel and life-style patterns is likely to vary for different types of destinations (Loukopoulos et al. 2006). Trips to visit family and friends, 86% of which were made as a vehicle driver or passenger, will be particularly difficult to reduce. The motivation to maintain these trips will be strong, and, short of a reverse trend that sees families relocating to be in closer proximity to one another or trips becoming unaffordable, they are likely to continue. An earlier New Zealand study investigating the potential impacts of an increase in the cost of private vehicle ownership suggested that, for some households, food and housing quality would be compromised before families would forgo car ownership. A car provides security that essential trips, including visits to family and health services, can be made (Witten et al. 2005). Such trips were not considered discretionary (Frank et al. 2007).

Social isolation is a possible outcome if mobility constraints limit a person's opportunities to spend time with family and friends. Under the carless days regime in 1979 many New Zealanders responded by postponing social and recreational travel. If a similar strategy were adopted now, the social consequences could be more severe as car reliance has increased in the intervening years. Māori households may be disproportionally affected by this scenario: under high fuel cost scenarios, retaining employment in urban areas while sustaining rural family/whānau connections will be particularly difficult. Similar limitations to maintaining face-to-face contact will confront those with networks of family/whānau and friends who are dispersed internationally.

Recreational trips to open spaces and to eating and drinking destinations may be more amenable to changes that reduce fuel use. Opting for a destination closer to home will often be feasible. This is evident in the NZTS data in that 23% of trips to open spaces and 25% of eating/drinking trips were made on foot. Many of the walking trips to open spaces were to

parks and reserves. New Zealanders have very good access to parks and reserves: a local, regional or national park can be reached within 2.4 minutes by car from three out of four New Zealand neighbourhoods (Witten et al. in press) and many of these parks could be reached on foot. Distances travelled by car by households in a Danish study were lower on weekdays and weekends where a green recreational area of 10 hectares or more was located within a kilometre of the dwelling (Naess 2006). Sponsored events and the provision of attractive amenities for public use in parks are likely to increase their use as local social and recreational destinations. Also, the burgeoning of New Zealand's so-called "coffee culture" has created a huge increase in local cafés as common social and recreational destinations (New Zealand Tourism Online 2008). While trips to local parks and cafés could increase if emission reduction strategies curtail longer-distance social and recreational travel, there could be a corresponding decrease in the frequency of weekend or holiday trips to a bach or beach house, another common feature of the Kiwi lifestyle dependent on private vehicle use.

Mode use for trips to sporting destinations was more akin to family and friend visits than to recreational trips to open spaces. Only 9% of trips were walking trips and 53% were made as a vehicle driver. Sporting activities often take place at specialised venues that are less numerous and more geographically dispersed than parks and reserves. Further, team sports often involve inter-club competitions that necessitate relatively long journeys, although car pooling may have the potential to reduce CO_2-e emissions in this situation. As rates of obesity are rising and physical activity levels falling (Ministry of Health 2003), care will be needed to ensure interventions designed to reduce CO_2 emissions do not indirectly discourage sporting participation.

Although TDM strategies are generally less useful for social and recreational travel, other approaches to reducing transport-related CO_2 emissions, such as the use of smaller-engine cars, more fuel-efficient cars, alternative fuels and electric vehicles, are equally effective for social and recreational trips as for other trips. Virtual mobility, using information and communication technologies, and certain approaches to urban design have also been promoted as useful strategies for lowering transport-related CO_2 emissions, but again they may not be as useful for social and recreational travel as for other types or travel. Although virtual mobility can substitute for trips to destinations such as banks and supermarkets, it is not considered an adequate replacement for face-to-face interaction with friends and family (Greenaway et al. in press), and may even increase rather than decrease demand for face-to-face contact (Adams 2005, Miller 2007).

Land-use changes that increase the dwelling density and decrease distances between work, home and play are strategies designed to shrink individual and household activity spaces and reduce travel demand (Cervero and Duncan 2006, Ewing et al. 2003). Changes in social and recreational travel patterns could follow if intensification is associated with better provision of recreational amenities, the location of major services and amenities (such as hospitals and retirement villages) on public transport routes, and improvements in public transport services in non-work hours. Locating regional sporting stadiums close to public transport routes and the provision of well-advertised occasion-specific public transport for events held at locations that are not near transport networks have been effective strategies to decrease the use of private vehicles. Unfortunately most social and recreational trips are not of this nature.

A compact urban form and easy access to a range of amenity destinations near where people live may increase walking trips (Saelens and Handy 2008), but there is no certainty that overall travel or CO_2 emissions will decrease accordingly. Handy (1996) investigated the

relationship between urban form and travel behaviour in the San Francisco Bay area and found higher accessibility − in terms of shorter trip distances and greater choice of destinations − was associated with *more* travel. The relationship was particularly marked for supermarkets and convenience store access. Trip frequency increased with choice of destinations, although a higher proportion of the trips were walking trips. Examining both local and non-local travel, a Norwegian study of energy use in eight residential areas in Oslo found that higher-density living reduced energy use for everyday travel but increased leisure-time travel. The investigators, Holden and Norland (2005), questioned whether high leisure-related energy use could be a long-term indirect effect of high-density living.

Economic and psychological explanations for the phenomenon of compensatory travel have been suggested. An escape hypothesis, whereby city dwellers seek contact with nature that is unavailable in the city, underpins the psychological explanation, and an economic argument suggests that a reduction in everyday intra-urban travel generates time and money savings that can be redistributed to weekend leisure travel (Naess 2006). Naess's investigation of travel behaviour in the Copenhagen region found weak evidence of compensatory weekend travel, but the overall weekly distances travelled by inner-city households were still lower than those of households in smaller urban areas.

Our study has a number of limitations. The destinations information available was not sufficient to categorise 19% of social and recreational trips in the NZTS database, and for those trips that were categorised the numbers of trips were only adequate for analyses of private vehicle and walking modes to be undertaken. Trip numbers were also too few for a comprehensive analysis of trip patterns by ethnicity or neighbourhood deprivation. Nevertheless, it has provided new information on the nature of social and recreational travel. In another phase of the research, travel data were gathered for nine consecutive days from residents living in diverse Auckland households. Subsequent in-depth interviews with participants enabled the meanings of their social and recreational trips to be explored as well as the essential versus discretionary nature of specific trips and the extent to which virtual communication could have been a feasible alternative to face-to-face contact. The findings of this work are reported elsewhere (Greenaway et al. in press).

Increasing affluence and relatively cheap access to private vehicles and, until very recently, cheap fuel have been associated with rising aspirations for mobility. However, if the overall costs of travel rise significantly in response to diminishing oil reserves and climate change, the size of people's social geographies are likely to shrink, and it will take time for people to reconfigure their social networks and adapt their travel patterns. As Axhausen points out, ultimately a new equilibrium is likely to be reached "which reflects the [evolved] infrastructures and fixed investments of society (housing, buildings in general, underground utilities, etc)" (Axhausen 2006:163).

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