By Community or Design? Age-restricted Neighbourhoods, Physical Design and Baby Boomers’ Local Travel Behaviour in Suburban Boston, US

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Abstract

This article analyses the travel behaviour, residential choices and related preferences of 55+ baby boomers in suburban Boston, USA, looking specifically at age-restricted neighbourhoods. For this highly auto-dependent group, do neighbourhood-related characteristics influence local-level recreational walk/bike and social activity trip-making? The analysis aims to discern community (for example, social network) versus physical (for example, street network) influences. Structural equation models, incorporating attitudes and residential choice, are used to control for self-selection and to account for direct and indirect effects among exogenous and endogenous variables. The analysis reveals modest neighbourhood effects. Living in age-restricted, as opposed to unrestricted, suburban neighbourhoods modestly increases the likelihood of residents being active (i.e. making at least one local recreational walk/bike trip) and the number of local social trips. Overall, the age-restricted community status has greater influence on recreational and social activity trip-making than the neighbourhood physical characteristics, although some community–neighbourhood interaction exists.

1. Introduction

Globally, the growing numbers of older adults, combined with changes in metropolitan settlement patterns, lifestyles and attitudes, have important implications for urban futures (for example, Champion, 2001). In many industrialised countries, ‘baby boomers’, the generation born during the period of sustained high birth rates following World War II, are now associated with distinctive approaches to consumption,
politics, personal finance, work and retirement, health and leisure (for example, Phillipson et al., 2008). Many of the industrialised world’s baby boomers came of age during a period of mass motorisation and suburbanisation and their travel behaviour has emerged as an important issue. Particularly in the US, the majority of older adults live in the suburbs and the great majority of their trips (87 per cent in 2009) are by car (US DOT, 2009). These lifestyle preferences, and ageing itself, pose challenges related to promoting active lifestyles and healthy ageing and reducing transport environmental and safety concerns (Rosenbloom, 2003). Examining baby boomers’ residential preferences and travel behaviours can help, at least, to inform neighbourhood design, transport policy and mobility service provision for the older adult cohort.

The range of innovations in products, markets and services increasingly geared towards an older adult society (Coughlin, 2007) includes residential living alternatives, such as age-restricted neighbourhoods. The US’ first age-restricted neighbourhood, Youngtown, Arizona, was built in 1954 on a 320-acre cattle ranch outside Phoenix and was designed as a socially active, affordable and child-free setting (Blechman, 2008). In the US as of 2005, 43 per cent (29.6 million) of owner-occupied housing had at least one member aged 55+; of these, approximately 3.3 per cent (1 million) were in age-restricted neighbourhoods; age-restricted housing accounted for 11 per cent of new homes bought by persons 55+ in 2003/04 (Emrath and Liu, 2007). To a lesser extent, similar developments are appearing in other Western nations (Grant and Mittelsteadt, 2004; Kennedy and Coates, 2008).

Our study explores the relationship between age-restricted neighbourhoods and baby boomers’ local travel habits. Ostensibly designed for older adult lifestyle preferences, age-restricted neighbourhoods might influence physical and/or social activity among residents, leading to healthier lifestyles. We examine this possibility, focusing on recreational walk/bike and local social trip-making among ‘leading-edge’ baby boomers (age 55–64 during data collection in 2008): comparing age-restricted neighbourhoods in suburban Boston with nearby non-age-restricted neighbourhoods; and assessing the effects of neighbourhoods’ physical characteristics. That is, we test two sources of behavioural effects: those arising from social (and other unobserved) characteristics of age-restricted neighbourhoods and those resulting from particular physical attributes. Although the setting is a metropolitan area in the US, insights may apply elsewhere.

2. Background and Research Questions

2.1 Key Concepts and Questions

In the US, baby boomers are generally recognised as those born between 1946 and 1964—78.2 million persons (25 per cent of the nation) in 2005. We focus on ‘leading-edge’ baby boomers, now approaching retirement age and currently qualifying for age-restricted (55+) housing residency. This cohort is the “key demographic targeted by developers and marketers of active adult housing” in the US (Heudorfer, 2005, p. 22). Here, ‘baby boomers’ refers to this leading-edge cohort while ‘older adults’ refers more generally to those 55+.

The two basic categories of older adult neighbourhoods are: planned developments, which include continuing care retirement communities offering on-site nursing/care facilities and leisure-oriented retirement communities, typically oriented around recreation (for example, golf courses); and unplanned communities—i.e. ‘naturally occurring retirement communities’ (NORCs) that organically evolve
into neighbourhoods with the majority of residents aged 55+ (Hunt and Gunter-Hunt, 1985).

We examine a particular type of planned older adult neighbourhood, the age-restricted, active adult neighbourhood, and behavioural differences its residents may display relative to residents in unrestricted neighbourhoods. From this point: ‘neighbourhood’ means a “geographically bounded unit in which residents share proximity and the circumstances that come with it” (Chaskin, 1995, p. 1); and, ‘community’ means the broader network of interpersonal relationships providing “sociability, support, information, a sense of belonging, and social identity” (Wellman, 2005, p. 53). A community might coincide with a neighbourhood; age-restricted neighbourhoods aim, partly, to create community. We exclude assisted living and congregated care facilities to control for the potentially different travel capabilities of individuals with assisted-living needs and, subsequently, the possible influences of neighbourhood designs specific to such residents. Thus, ‘age-restricted’ refers to age-restricted, active adult neighbourhoods and ‘unrestricted’ refers to neighbourhoods without explicit age restrictions. We use the age-restricted status as a proxy for community.

Finally, we study two types of individuals’ local activities

—local recreational walking and bicycle use—hereafter, ‘recreational non-motorised transport’ (NMT), because increasing physical activity helps healthy ageing and local NMT can satisfy recommendations for older adults’ regular moderate physical activity (for example, DiPietro, 2001; Eyler et al., 2003); and

—local social engagement—hereafter, ‘social trips’—since being socially ‘disengaged’ may lessen physical and mental health and residential

neighbourhoods can maintain and increase social networks via proximity and shared physical settings, enhancing residents’ well-being (for example, Kweon et al., 1998; Yang and Stark, 2010).

Separating these trip types adds important nuance to the analysis, as neighbourhoods and communities might vary in their impacts on different travel behaviours and individuals may choose particular settings to satisfy certain behavioural preferences; the settings, in turn, may then influence other behaviours. In this paper, being ‘social’ and making social trips refer to individual characteristics and activities; ‘community’ refers to the broader network of interpersonal relationships, as already defined and as we distinguish based on the restricted/unrestricted neighbourhood of residence.

2.2 Research Precedents

Scholars and others have long been interested in older adults’ travel behaviour (for example, Wachs, 1979). Relevant recent research includes transport’s contribution to older adults’ well-being in Vancouver (Cvitkovich and Wister, 2001), trip generation rates and travel distances in London (Schmöcker et al., 2005) and satisfaction with travel opportunities in Sweden (Wretstrand et al., 2009). Studies have only more recently focused specifically on the relationship between the built environment and older adults’ travel behaviour.

Due to our research focus, we limit the literature review to studies of: ‘objective’ measures of the built environment and relationship with NMT use; and, effects of neighbourhood and community characteristics on older adults’ walking behaviour and social engagement.

The built environment and walking. Research consistently reveals associations
between utilitarian walking and factors like proximity to destinations and public transit, street connectivity, mixed land use and higher residential and job density (for example, Baran et al., 2008; Giles-Corti and Donovan, 2002; Giles-Corti et al., 2005; Huston et al., 2003; Lee and Moudon, 2006; Moudon et al., 2005; Saelens and Sallis, 2003). On the other hand, research focused on walking for recreation and exercise provides inconsistent results (Owen et al., 2004). Some studies show that sidewalks (Giles-Corti and Donovan, 2002), accessible destinations (Giles-Corti et al., 2005), hilliness (Lee and Moudon, 2006) and perception of attractiveness and safety (Alfonzo et al., 2008; Giles-Corti and Donovan, 2002) are associated with a higher level of recreational walking; other studies fail to reveal such correlations (Rodriguez et al., 2006; Saelens and Sallis, 2003).

Older adults' NMT use. King et al. (2003), examining older women (average age 74) in suburban and urban Pennsylvania, find a positive correlation between physical activities (pedometer-measured) and convenient destinations and perceived walkability. Berke et al. (2007a) find neighbourhood walkability in King County, Washington—measured via a spatial buffer of households and accounting for characteristics like dwelling unit density and proximity of grocery stores—to be inversely associated with depressive symptoms in older (65+) men (but not women). Berke et al. (2007b) also find a statistically significant relationship between the same walkability measure and frequency of older persons’ (65+) walking for physical activity. Examining older people’s (65+) travel behaviour in northern California and controlling for attitudes, Cao et al. (2010) find that several neighbourhood characteristics (for example, safety, distances) influence walk trip frequencies. Joseph and Zimring (2007) examine older adults’ (age 77–83) path choice in three continuing care retirement neighbourhoods in Atlanta, finding an association between: well-connected, destination-oriented paths and utilitarian walking; and longer, well-connected paths without steps and recreational walking. Finally, using multilevel regression, Nagel et al. (2008) find that high-volume streets and proximity to destinations positively influence total walking time among older adults (average age 74) in Portland (Oregon), while low-volume streets have a negative influence on total walking time. They find no association between the built environment and the odds of not walking, suggesting no neighbourhood influence on sedentary older adults’ walking behaviour.

Neighbourhood, community and older adults’ social activities and/or well-being. Early US studies took a building-level perspective, often focusing on government-supported housing (Lawton et al., 1975). In Portland (Oregon), Chapman and Beaudet (1983) found older adults’ (average age 78) interactions with neighbours to be highest in ‘good quality’ neighbourhoods, more distant from the city centre, and with low shares of older people. Kweon et al. (1998) found a positive association between time spent in common outdoor green spaces and measures of social integration and ‘sense of local community’ among poor 64+ adults (average age 68) in Chicago’s age-integrated public housing. Finally, Yang and Stark (2010), using qualitative methods, find apparent behavioural influences of social features related to expectations of encounters and homogeneity of residents in assisted living facilities (stand-alone buildings).
2.3 Age-restricted Neighbourhoods and Travel Behaviour: Hypotheses

Little research has focused specifically on local travel behaviour in age-restricted neighbourhoods. As mentioned, Joseph and Zimring (2007) examined walk path choice in continuing care retirement neighbourhoods. Flynn and Boenau (2007) estimated vehicular traffic counts for a suburban Virginia age-restricted neighbourhood, finding trip rates comparable to those recommended for detached senior adult housing by the Institute of Transportation Engineers.

Avoiding the broader debate about age-restricted neighbourhoods (see Blechman, 2008), we identify features that may influence local NMT use and social engagement. Specifically, relative to unrestricted neighbourhoods, age-restricted neighbourhoods may differ by (Hebbert, 2008)

—demographics: people of similar ages and interests, combined with physical disconnection from surrounding neighbourhoods, may decrease the likelihood of encountering strangers in day-to-day activities;
—community: programmes, events, clubhouses may increase residents’ activity levels;
—suitability: targeting the 55+ demographic and offering lifestyle choice amenities (like golf courses, pools) may support more active living; and
—walkability: trails and sidewalks, and little, if any, through-traffic may increase walking.

Age-restricted and unrestricted neighbourhoods also share many similarities. The great majority (71 per cent) of age-restricted neighbourhoods in the US are suburban, even more suburban than overall locations of older adult households (Emrath and Liu, 2007).² This implies limited connectivity to other neighbourhoods, limited local retail, dispersed employment and other services, and limited public transport. In this suburban context, we focus locally, where physical and community differences and, thus, potential behavioural effects may arise.

Do age-restricted neighbourhoods influence local travel behaviour? The social ecological model offers a theoretical frame for local travel behaviour in age-restricted neighbourhoods, emphasising the reciprocal interactions between behavioural and environmental factors. Presuming that changes in community alter individual behaviours, the model focuses on relationships between environmental interventions and interpersonal, organisational and other community factors (Sallis and Owen, 1996). Age-restricted neighbourhoods may support older adults through peer groups, social programmes and higher perceived safety, among other things (for example, Ahrentzen, 2010). We hypothesise that, after controlling for physical characteristics, age-restricted neighbourhoods have more recreational NMT and social trips due to community effects.

Do neighbourhood characteristics influence local travel behaviour? As Maat et al. (2005) propose, a neighbourhood’s physical characteristics may influence travel behaviour via effects on net utility—the utility of travel (for example, number, quality, distribution of destinations) less its disutility (actual and perceived travel costs). Consider, for example, prototypical street configurations: linear, loop and grid (see Figure 1). The latter two reduce nonduplicative routes (reducing travel’s disutility) and, by clustering dwellings, increase opportunities to meet neighbours (increasing travel’s utility). Thus, we hypothesise that grid- and loop-type neighbourhoods promote more recreational NMT and
social trips, as do higher intersection density, neighbourhood facilities (for example, parks, golf course) and proximity to other destinations, including public transport stops.

2.4 Analytical Challenges and Specific Modelling Precedents

Aiming to show whether neighbourhoods’ community and physical characteristics produce different activity patterns, poses the classic causality challenge, associated with ‘self-selection’ (Mokhtarian and Cao, 2008). At least two related forms of bias may be present: simultaneity bias (for example, individuals who prefer walking choosing to live in walkable neighbourhoods); and omitted variable bias (unobserved variables, like preferences for walking, produce the travel outcome (walking), but also correlate with neighbourhood characteristics). In other words, the presumed exogenous causal variable, the neighbourhood, is actually endogenous, which can produce inconsistent and biased estimators. Mokhtarian and Cao (2008) review the issues and possible analytical and research design solutions. Cao et al. (2009) review 38 empirical studies using nine different approaches to control for ‘self-selection’—direct questioning, statistical control, instrumental variables, sample selection models, propensity score matching, other joint models of residential and travel choices (for example, structural equation models) and longitudinal studies.

Only statistical control and structural equation models are reviewed here. Statistical control directly incorporates attitudes and preferences into the behavioural model, thereby isolating these effects from neighbourhood-level effects. Studies typically use specialised survey data, including attitudes and preferences (for example, measured on a Likert scale), in a two-step approach: factor analysis on the indicators (since multiple preferences/attitudes are measured); and, behavioural modelling, including fitted values from the first step (for example, Cao et al., 2006, 2010). Problematically, the estimation of the second step is inconsistent because the fitted latent variables (from the first step) include measurement error by dropping error terms (Ben-Akiva et al., 2002).

The latter problem can be addressed with structural equation modelling (SEM), an analytical tool introduced in the travel behaviour field in the 1980s (Golob, 2003) and more recently applied to the self-selection issue (Cao et al., 2009). A full SEM uses simultaneously estimated measurement models, for endogenous and exogenous variables, and a structural model, and can capture influences of exogenous on endogenous variables and among endogenous variables (Golob, 2003). SEM measurement models are similar to exploratory factor analytical approaches, except in restricting the parameters defining factors and specifying covariances among unexplained portions of both unobserved and latent variables (Golob, 2003). The estimated parameters make the predicted variance–covariance matrix as similar as possible to the observed variance–covariance matrix, subject to model constraints. SEM can distinguish between direct and total effects and, with simultaneous measurement equations of latent variables, allows consistent incorporation of attitudes and preferences in behavioural models and captures potential bi-directional influences between attitudes and travel behaviour (Mokhtarian and Cao, 2008).

Few studies have used SEM to introduce latent attitudinal variables in the built environment/travel behaviour context. Abreu et al. (2006) used SEM in analysing adult workers’ travel in Lisbon, treating short- and longer-term travel behaviours and
Figure 1. Three categories of neighbourhood street patterns, descriptive diagrams and prototypical examples of the categorisation.
Source: World Imagery, provided by ESRI (http://www.arcis.com/home/item.html?id=10df2279f684e4a9f6a7f08febac2a9).
residence and workplace land use characteristics (latent variables identified through exploratory factor analysis) as endogenous variables and individual socioeconomic variables as exogenous. The approach partially accounts for self-selection while not explicitly including attitudinal effects; the structural and measurement models are not estimated simultaneously. Bagley and Mokhtarian (2002) included attitudes in a SEM, including endogenous variables (two residential type variables, one job location variable, three travel demand variables and three attitude variables) and exogenous variables (socio-demographics, lifestyle factors, attitude measures). They found that attitudes and lifestyles exerted the greatest influence on travel behaviour, while residential location type had little impact. The study represented neighbourhood characteristics via factor scores on two dimensions (traditional versus suburban) and included latent variables as fitted values of factor analysis on indicators, rather than simultaneously estimating structural and measurement equations. Similar to Abreu et al. (2006), their model is path analysis rather than complete SEM.

In summary, for the highly automobile-dependent, yet relatively understudied, baby boomer generation in the suburban US, we ask the question: do neighbourhood-related characteristics influence local-level recreational walk/bike and social activity trip-making? Drawing from social ecological theory and utility-based travel behaviour theory, our analysis aims to discern community (for example, social network) versus physical (for example, street network) influences. Unlike most previous research in this field, we use full structural equation models, incorporating attitudes and residential choice, to control for self-selection and to account for direct and indirect effects among exogenous and endogenous variables.

3. Research Context and Design

Greater Boston includes 164 cities and towns, with 4.45 million persons (in 2000), across 2832 square miles (6107 square km). Just over 20 per cent of residents are older adult (US Census Bureau, 2002), a cohort expected to increase by 50 per cent between 2000 and 2020 (Heudorfer, 2005). Approximately 8.5 per cent of Greater Boston residents in 2000 were ‘leading-edge’ boomers (US Census Bureau, 2002), a group slightly more suburban than the overall population.4

These demographic trends, and local land use policies and fiscal considerations, have fuelled age-restricted development. State-wide, Heudorfer (2005) found 150 age-restricted neighbourhood developments completed or under construction in 93 cities and towns, implying a supply of more than 10 000 housing units, with another 170 age-restricted developments in pre-construction or seeking permissions in 109 towns. Most developments have fewer than 100 dwelling units and include walking paths, meeting rooms and clubhouses, with fewer providing on-site shops, bike trails and golf facilities (Heudorfer, 2005).

3.1 Survey Design and Data

We use a quasi-experimental, cross-sectional research design comparing suburban age-restricted and unrestricted neighbourhoods in Greater Boston. The age-restricted neighbourhoods were first identified—via real estate listings, information from developers and other resources5—based on the following criteria: built out and occupied; entirely or mainly age-restricted; and ‘active adult’ (for example, not a continuing care facility). Thirty-five age-restricted neighbourhoods met the initial criteria. From this list, 20 neighbourhoods were selected (see Table 1), by filtering out recent developments (to
ensure potential residency of at least three years) and small developments (less than 30 units on a single street). The final sampled age-restricted neighbourhoods range in size from 40 to 1100 dwelling units with a mean of 160 and median of 66 units. Our models control for the possible influence of neighbourhood size by including total street length in each age-restricted and unrestricted neighbourhood. Overall, the selected neighbourhoods are biased towards more recent developments and/or ones with recent real estate activity.

Each age-restricted neighbourhood was matched with unrestricted surroundings using postal codes to approximate similar regional accessibility and demographics. Mailing addresses were requested from USAData, a commercial data vendor, for residents aged 55–65, generating 34 108 names. We identified 1237 households in age-restricted neighbourhoods by matching street names against the purchased list. We then randomly sampled 5763 households from unrestricted areas, producing a total sample size of 7000 households. We purposely oversampled unrestricted areas, expecting to receive a lower response rate from the cohort of interest there. Our sampling approach is endogenously stratified.

Mailed survey packages included a $5 non-contingent cash incentive, a travel survey for retrospective trip counts over the past week; attitudinal questions, such as preferences for walking and cycling (five-point Likert scale); and household/individual questions (for example, income, employment status). We received 1650 household responses, 1422 after excluding problematic responses (effective response rate of 20 per cent): 349 from age-restricted neighbourhoods (28 per cent response rate) and 1073 from unrestricted neighbourhoods (19 per cent response rate). Households included 1859 individuals (470 age-restricted; 1389 unrestricted). Among the 20 age-restricted neighbourhoods, responses came from 15 (Table 1).

Table 1. Age-restricted neighbourhoods examined (15 from which we received responses: 28 per cent response rate)

| ID | Community                  | Households | Persons | Map |
|----|---------------------------|------------|---------|-----|
| 1  | Adams Farm                | 14         | 21      |     |
| 8  | Deerfield Estate          | 7          | 10      |     |
| 9  | Delapond Village          | 2          | 2       |     |
| 11 | Eagle Ridge               | 11         | 15      |     |
| 17 | Leisurewoods              | 25         | 31      |     |
| 20 | Oak Point                 | 95         | 128     |     |
| 21 | Pinehills                 | 87         | 116     |     |
| 23 | Red Mill                  | 6          | 8       |     |
| 25 | Southport                 | 35         | 45      |     |
| 27 | Spyglass Landing           | 5          | 6       |     |
| 30 | The Village at Meadwood   | 16         | 22      |     |
| 31 | The Village at Orchard Meadow | 17   | 23      |     |
| 32 | Village at Quail Run      | 11         | 15      |     |
| 33 | Vickery Hills             | 14         | 23      |     |
| 35 | Wellington Crossing       | 4          | 5       |     |
| Total |                        | 349       | 470     |     |

Notes: The shading on the map indicates towns with one or more ARAACs, as tabulated by Heudorfer (2005). Numbered dots indicate locations of ARAACs identified for this study.
Neighbourhood characteristics were measured using a geographical information system (GIS) and public and private data sources, based on household location (identifiable to the centroid of a 250-metre grid cell; see the example in Figure 1). 7

3.2 Measures and Descriptive Statistics

Table 2 includes descriptive statistics of key variables, including outcomes of interest, reported weekly: NMT trips, representing recreational walking/biking trips; and social trips, measuring visits to neighbours and representing local social engagement. Respondents in age-restricted neighbourhoods have only slightly higher average weekly trip rates for both trip purposes. A large share of individuals in both neighbourhood types report making zero NMT and social trips during the week (hereafter, these individuals are ‘non-active’ and ‘non-social’). Unrestricted neighbourhoods have a 10 per cent higher share of non-active and a 13 per cent higher share of non-social individuals. Baby boomers residing in age-restricted neighbourhoods tend to be less employed, slightly healthier and slightly older, with fewer owning a bike or more than three cars. Age-restricted neighbourhoods have more local facilities, such as public spaces, and, primarily, loop street patterns. None has grid streets. Nearly 50 per cent of unrestricted neighbourhoods have linear street patterns. Other physical characteristics—such as intersection density, destinations and proximity to public transport—do not significantly differ between sampled restricted/unrestricted neighbourhoods.

Exploratory factor analysis on the responses to the questions regarding residential preferences led us to hypothesise two latent variables: Pro Walkability, denoting preference for walkable neighbourhoods, and Pro Segregation, representing preference for neighbourhoods segregated by age and social class. Confirmatory factor analysis confirms this latent structure: fixing the indicators most highly correlated with the two latent variables at 1 for identification, all other indicators significantly contribute to the latent variables. This latent construct serves as a measurement model in the following SEM. 8

4. Behavioural Modelling

The large share of zero-reported NMT and social trips (Table 2) indicates censoring—ordinary count models may be inappropriate. We employ a zero-inflated model, allowing zeros to remain in the count model by estimating an individual’s likelihood of being in the ‘zero’ group. Taking recreational NMT trips as an example, a binary logit model estimates the probability of being non-active and active. These probabilities weight the zeros in the count model such that the probability of observing zero for an individual equals the probability of being non-active plus the probability of being active, multiplied by the probability of observing zero in the count model (Jones, 2005) (Figure 2, Equations (1)–(3)). This produces two sets of coefficients. The logit model results indicate the variables’ influence on the likelihood of being non-active; negative coefficients imply a higher probability of being active. The count model estimates trip counts for the active group; positive coefficients mean a higher frequency of recreational NMT trips.

We apply zero-inflated negative binomial (ZINB) models 9 with SEM that simultaneously incorporates attitudes possibly affecting residential choice/travel behaviour and a residential choice model. Three types of relationship are examined—residential choice, residential preference and travel behaviour (Figure 2)—and three models
Table 2. Descriptive statistics by neighbourhood type and tests of differences

| Variables                             | Total | Age-restricted | Unrestricted | Mean difference |
|---------------------------------------|-------|----------------|--------------|-----------------|
|                                       | N     | Mean (S.D.)    | Mean (S.D.)  |                 |
| **Dependent variables**               |       |                |              |                 |
| NMT trip                              | 1761  | 2.235 (2.417)  | 2.629 (2.451)| 2.101 (2.391)   | 0.528**         |
| Individuals reporting zero NMT trips  | 704   | 0.400          | 0.324        | 0.426           | 0.102**         |
| Social trip                           | 1755  | 0.801 (1.322)  | 1.084 (1.472)| 0.706 (1.253)   | 0.378**         |
| Individuals reporting zero social     | 1075  | 0.613          | 0.514        | 0.646           | 0.132**         |
| trips over past week (i.e. non-social)|       |                |              |                 |
| **Question predictor (treatment)**    |       |                |              |                 |
| ARAAC                                 | 1859  | 0.253          |              |                 |
| **Socio-economic characteristics**    |       |                |              |                 |
| Employ                                | 1846  | 0.637          | 0.510        | 0.680           | 0.170**         |
| Healthy                               | 1859  | 0.851          | 0.892        | 0.837           | 0.054*          |
| Male                                  | 1849  | 0.472          | 0.444        | 0.482           | 0.038           |
| Age                                   | 1760  | 61.195 (3.875) | 62.651 (3.750)| 60.687 (3.790) | 1.963**         |
| High-income                           | 1761  | 0.298          | 0.330        | 0.287           | 0.043           |
| Mid-income                            | 1761  | 0.496          | 0.501        | 0.495           | 0.006           |
| Low-income (base)                     | 1761  | 0.205          | 0.169        | 0.218           | 0.049*          |
| Three vehicles                        | 1668  | 0.259          | 0.137        | 0.301           | 0.164**         |
| Bike                                  | 1645  | 0.573          | 0.519        | 0.592           | 0.072**         |
| (continued)                           |       |                |              |                 |
## Table 2. (Continued)

| Variables                        | Total | Group mean (S.D.) | Age-restricted | Unrestricted | Mean difference |
|----------------------------------|-------|-------------------|----------------|--------------|-----------------|
|                                  | N     | Mean (S.D.)       |                |              |                 |
| **Neighbourhood characteristics**|       |                   |                |              |                 |
| Grid                             | 458   | 0.234             | —              | 0.242        | 0.242*          |
| Loop                             | 458   | 0.295             | 0.800          | 0.278        | 0.522**         |
| Linear                           | 458   | 0.472             | 0.200          | 0.481        | 0.281*          |
| Intersect density                | 458   | 0.322             | 0.392          | 0.320        | 0.072           |
| Facilities                       | 458   | 0.349             | 0.733          | 0.336        | 0.397**         |
| Destination 400                  | 458   | 0.448             | 0.600          | 0.442        | 0.158           |
| MBTA bus stop                    | 458   | 0.066             | 0.133          | 0.063        | 0.070           |
| Commuter rail                    | 458   | 0.222             | 0.200          | 0.223        | 0.023           |
| Street length                    | 458   | 2.977             | 5.396          | 2.895        | 2.501           |

**Notes:** *p < 0.05, **p < 0.01, indicating significance levels of difference of means/proportions; — indicates not applicable. Some totals differ due to missing items in the sample.
are estimated (the Appendix provides full results). Model 1 has no control for self-selection. Model 2 attempts to control for individuals’ self-selection for neighbourhood physical characteristics by simultaneously estimating the ZINB model and the
latent variable (attitudinal) model’s structural and measurement equations. Model 2 estimates residential preferences conditional upon socioeconomic characteristics; thus, travel behaviour and residential preferences are endogenous while socioeconomic status and neighbourhood physical characteristics and age-restricted status are exogenous. Model 3 includes a binary choice model for age-restricted status, assuming that people select age-restricted neighbourhoods to satisfy community preferences, and that neighbourhood and individual characteristics influence age-restricted choice. In this case, age-restricted neighbourhood choice, residential preferences and individual and neighbourhood characteristics jointly affect local travel behaviour. We estimate the models in MPlus 5.0, using a normal theory maximum likelihood (ML) estimator and accounting for non-independence among observations from the same household (Muthén, 1998–2004; Muthén and Muthén, 1998–2007).

4.1 Recreational NMT

The recreational NMT trip results directly support our first hypothesis regarding the effect of age-restricted setting, with some support for neighbourhood physical characteristics, but only ‘bundled’ with age-restriction. Figure 3 orients the discussion.

Examine, first, the age-restricted neighbourhood choice: after controlling for neighbourhood characteristics, age-restricted neighbourhoods attract older, higher-income people who prefer segregated neighbourhoods. Males are less likely to choose age-restriction. Age-restricted neighbourhoods with loop-type streets, higher intersection density and on-site facilities are more attractive.

Looking at the likelihood of being non-active, neighbourhood physical characteristics—loop street type, intersection density, presence of local facilities, total street length—do have an influence, but only indirectly, via the age-restricted choice. Community and design primarily influence the non-active likelihood, with only nearby destinations exerting a significant effect on number of trips among the active. Nearby commuter rail, interestingly, negatively correlates with number of recreational NMT trips.

For individuals, being employed increases the likelihood of being non-active and decreases the number of NMT trips among the active. Being healthy decreases the likelihood of being non-active. Finally, ‘pro-Walkables’ are less likely to be non-active, while ‘pro-Segregated’ are more likely to be. This latter effect is partly offset by the pro-Segregated choosing age-restricted neighbourhoods that, in turn, increase the likelihood of being active.

There is little evidence of self-selection for local NMT trips. While both latent attitudinal constructs significantly affect the choice to be active, they do not change the sign, significance or magnitude of the age-restricted effect. Age-restricted community settings increase the chance that residents will make local recreational NMT trips; perhaps, in part, due to neighbourhood physical characteristics. Other than nearby destinations’ effect on NMT trip counts, neighbourhood physical characteristics do not directly affect baby boomers’ being active or the number of recreational NMT trips.

4.2 Social Trips

The social trip results also only partially support our hypotheses, with distinct, somewhat counter-intuitive, differences relative to recreational NMT. Age-restricted settings and, indirectly, their bundled physical characteristics exert an uncertain influence on the number of social trips. Physical
Figure 3. Path diagram and results of recreation NMT (left) and social trips (right) models.

Notes: Results are from model 3 in the Appendix (Tables A1, A2); $p < 0.10$; * $p < 0.05$; ** $p < 0.01$. 
characteristics themselves only modestly (and uncertainly) influence the likelihood of being ‘social’. Again, Figure 3 guides the discussion.

The same age-restricted choice model as for recreational NMT holds. However, contrary to the NMT case, age-restricted neighbourhoods do not affect being social; among the social, age-restriction increases social trip-making. This result should be viewed with some uncertainty (p-value = 0.075) and suggests residential self-selection vis-à-vis social trip-making (compare the significance of the age-restricted neighbourhood coefficient from model 1 with models 2 and 3; Appendix, Table A2). Those inclined to make more social trips may select age-restricted settings (and, possibly, their physical characteristics) to satisfy social trip-making tendencies. Regarding direct physical effects, street typologies are insignificant. Nearby commuter rail is associated with being social and making more local social trips (p <0.10).

For individuals, being employed increases the likelihood of being non-social. Unsurprisingly, being employed reduces weekly local social trip-making. Older boomers have greater likelihood of making more social trips. Finally, those preferring segregated neighbourhoods have a higher likelihood of making more social trips.

Social trips offer stronger evidence of self-selection in this study. While age-restricted neighbourhoods appear to be associated with more weekly social trips among the socially inclined, statistical support for this effect declines once accounting for attitudes and residential preferences.

5. Implications and Shortcomings

Our findings must be viewed in light of the demographic geography of older adults in the metropolitan US: the majority live in auto-dependent suburbia. Among our sampled individuals, for example, 93 per cent of daily reported trips were by automobile (Hebbert, 2008), even higher than the automobile mode share for Greater Boston’s baby boomers. This study sheds little light on the larger challenges implied. Nonetheless, with respect to two types of local travel activities that may be influenced by suburban neighbourhood and community characteristics and play an important role in healthy ageing, some influences emerge.

We find modest effects of neighbourhood age-restricted status and physical characteristics on weekly recreational NMT and social trip-making. Distinguishing between those who do and do not make a recreational NMT or social trip provides useful information. Eyler et al. (2003), studying adults in the US, identified three types of walker: regular, occasional and never. Occasional and never walkers lacked time for walking and never walkers reported feeling unhealthier, while regular walkers reported more self-confidence and social support for walking. Our recreational NMT results support these findings and suggest a design and community (social network) role: those with a ‘pro-Walkable’ mindset are more likely to be active; the community and, indirectly, design aspects of age-restricted neighbourhoods increase residents’ likelihood of being active, after controlling for self-selection. This provides some support for the social ecological model of health promotion—the social-physical setting of the age-restricted neighbourhoods apparently provides a medium for active living (for example, Wister, 2005). Among the active, however, the neighbourhood has no effect on increased recreational NMT trip-making, although nearby destinations do play a role. The age-restricted effect may come from social settings (i.e. community) or other unobserved (or non-comparable) physical characteristics distinguishing age-restricted from unrestricted suburbs. For
example, the age-restricted neighbourhoods studied have more local facilities (for example, clubhouses) than typical suburbs (Table 2); while insignificant in the NMT models, these variables’ effects may be masked by the age-restricted label.

As in the recreational NMT case, some age-restricted physical characteristics (intersection density, neighbourhood facilities and destinations) indirectly influence social trip-making among the social. In this case, however, residents may be purposefully choosing age-restricted settings and their related design attributes: age-restricted settings will not ‘make’ people social, but may attract those with higher social trip-making tendencies.

Our findings indicate the importance of distinguishing between trip types, including when attempting to control for self-selection. The results confirm intuition: an individual may choose a neighbourhood to satisfy desired local social activity; this residential choice to satisfy one activity preference might then induce changes in other activities.

5.1 Limitations and Future Research

Our results are only directly applicable to a specific demographic, geography and time of year (i.e. April 2008) and may not be generalisable. Even for the specific groups and areas studied, it is likely that the sampling procedure suffers from biases that further limit the results’ validity and generalisability.

The age-restricted effects may be confounded by our not knowing whether some of the unrestricted neighbourhoods also have a high share of older adults (i.e. being NORCs), implying similar community structures. This relates to spatial dependence—participation in a particular activity may be influenced by surrounding neighbourhoods, including how well ‘integrated’ the neighbourhoods are with their surroundings, only crudely proxied here.

The age-restricted neighbourhoods’ relative newness may also confound; newer residents may still be ‘exploring’ surroundings, effects indistinguishable from the age-restricted status. Over time, such effects may diminish or intensify—an area for further study.

Analytically, complete SEM—simultaneously estimating measurement models of latent attitudinal variables and behavioural (structural) models—represents an important advance. It controls for self-selection based on attitudes and residential choice and allows testing more complex relationships, including direct and indirect effects. The increased modelling sophistication also comes at a cost—our particular SEM cannot easily reveal relative or marginal effects, only significance and directionality. Furthermore, the design remains cross-sectional, as opposed to temporal (i.e. measuring change). For example, people living in a sociable community and/or a social-oriented neighbourhood may increase, over time, their socialising, which may then change the community (for example, walking groups); revealing these dynamics would require longitudinal analysis.

Questions can be raised about the outcomes measured: self-reported recreational NMT trips in the neighbourhood and social trips to ‘neighbours’. Respondents may interpret the extent of ‘neighbourhood’ and/or ‘neighbours’ differently. Further, the measures may be weak proxies for outcomes more closely related to healthy ageing, such as: minutes of activity per day, health conditions, levels of social engagement, strength of social networks and/or mental health conditions. Analogously, the validity and reliability of the attitudes/preferences questions are uncertain and treating the ordinal Likert-value attitude scores as continuous
variables (in the factor analysis), although common practice, may be problematic.

Regarding neighbourhood built environment, we attempted ‘objective’ measurement, which may not account for design qualities like sense of safety and human scale (Ewing and Handy, 2009) and may ignore individual perceptions of relevant factors. Again, these perceptions may change over time and be influenced by neighbourhood and/or community changes. Enhanced behavioural insights might come from combining qualitative measures of the built environment with ‘objective’ measures.

Further research could examine additional travel behaviours among baby boomers and/or compare suburban and urban baby boomers or age-restricted neighbourhoods with non-age-restricted master planned neighbourhoods. Such comparisons may reveal whether the modest behavioural effects of age-restricted neighbourhoods derive from the community structure, physical features or their reciprocal interactions. Additional topics worth examining include: the potential to retrofit existing neighbourhoods to serve the needs of older adults more effectively; whether spatial concentrations of older adults in suburbia increase possibilities for new transport and/or other older adult services; and the relationship between commuter rail proximity and local trip-making.

Our results indicate the need to reach a better understanding of how physical and social structures interact to influence older adults’ activities. Overall, however, the relative locations of older-adult-oriented neighbourhoods need attention. For example, just 13 per cent of the age-restricted neighbourhoods studied are within 1 km of a bus stop and 20 per cent within 1 km of commuter rail. As ageing means reduced driving capabilities, this relative automobile-dependency may pose a problem.

6. Conclusion

We studied a neighbourhood type catering for older adults—age-restricted, active adult neighbourhoods—and attempted to discern community (for example, social network) versus physical (for example, street network) influences on suburban baby boomers’ travel behaviour. Using structural equation models, the analysis attempts to control for self-selection based on attitudes and residential choice, allowing for direct and indirect effects among exogenous and endogenous variables.

The age-restricted neighbourhoods attract older, higher-income baby boomers who prefer age-segregation. These communities increase the likelihood of boomers being active—i.e. making at least one local recreational NMT trip—but not the number of NMT trips among the active. Physical characteristics have only an indirect effect, by influencing the decision to live in age-restricted settings. In contrast, age-restriction has no effect on being social (i.e. the likelihood of ever visiting neighbours); among the social, however, age-restriction increases social trip-making, although perhaps due to self-selection. In other words, age-restricted neighbourhoods are associated with higher levels of local social activity, but because they attract more socially inclined residents. The age-restricted effect may stem from a sense of community fostered in age-restricted neighbourhoods and/or unobserved or intermingling physical characteristics.

Our analysis indicates the importance of distinguishing between trip types when controlling for self-selection in the built environment/travel behaviour research. It also suffers from a range of limitations, including generalisability, unknown relative magnitude of effects and inability to assess impacts over time. While this research offers some insight into the
influence of age-restricted neighbourhoods on baby boomers’ local travel behaviours, it says nothing about the regional travel patterns of this highly suburbanised, automobile-dependent generation.

Notes

1. In the US, the Department of Housing and Urban Development (HUD) uses senior housing, or 55 and older community; residential developer Del Webb refers to ‘active adult communities’ (Harris Interactive, 2005); the National Association of Homebuilders suggests that ‘age-qualified’ is preferred (Emrath and Liu, 2007).

2. Overall older adult (and age-restricted) household locations in the US: 23 per cent (14 per cent) central cities; 50 per cent (71 per cent) suburbs; and 27 per cent (15 per cent) outside metro areas (derived from Emrath and Liu, 2007, Tables 1 and 2).

3. A sample selection problem may also exist: among the possible sub-samples of baby boomers, factors influencing residential location choice for our age-restricted sub-sample could also influence behaviour. In our case, this problem effectively appears as a form of omitted variable bias (Hebbert, 2008).

4. Based on share of census population in 2000, accumulated over the corresponding census block centroid’s distance from Boston’s central business district.

5. Heudorfer (2005) inventoried (apparently based on a survey of town officials) age-restricted housing in the state, but did not identify individual developments.

6. Problematic responses included: addresses non-geo-locatable or outside the study area (due to mail forwarding); no household survey page; age outside the cohort of interest. Hebbert (2008) provides detail on survey design, implementation and results.

7. The grid cell approach ensures anonymity, making it impossible to identify the household’s address. The centroid of the 250-metre grid cell serves as the household ‘location’. Each grid centroid was visually associated to a neighbourhood based on primary street characteristics (see Figure 1). Basic data, including roads, parcels, commuter rail, come from MassGIS (http://www.mass.gov/mgis/), although available data were limited. For example, no building footprints for sample neighbourhoods could be located and road networks in the newer age-restricted neighbourhoods were outdated. We updated missing data using a high resolution aerial photo from ESRI (http://www.arcgis.com/home/item.html?id=a5fef63517cd4a099eb437e55713d3d54) to classify street patterns and compute intersection density. For other neighbourhood characteristics (for example, public spaces, outdoor sports facilities), we used Google Earth’s satellite imagery and ‘Places’ layer, and, in some cases, site plans and age-restricted neighbourhoods’ webpages.

8. Space constraints preclude including the confirmatory factor analysis (CFA). Refer to the measurement models in Tables A1 and A2; full results available upon request.

9. For the NMT and social trip models, the Vuong test indicates that ZINB is preferable to a regular negative binomial; and a likelihood ratio test indicates that ZINB is preferable to a zero-inflated Poisson.

10. As mentioned in the sample description, our sample is endogenously stratified. In the age-restricted neighbourhood choice (logit) models, this choice-based sampling results in an inconsistent alternative specific constant, while other coefficients are consistent (Manski and Lerman, 1977). We attempt to correct for this sampling strategy by using weights in the choice model estimation: \( p/s \) for households in age-restricted communities and \( (1-p)/(1-s) \) for households from unrestricted communities, where \( p \) is the probability of a household living in an age-restricted community from the population and \( s \) is the proportion of households from our sample living in an age-restricted community. As a value for \( p \) is not available, we use 3.2 per cent (Emrath and Liu, 2007). We test the sensitivity of results.
to this value by estimating the models with $p = 1$ per cent and 6 per cent (reasonable upper and lower bounds); the results do not vary substantively. Full sensitivity analyses are available upon request.

11. We sampled households but model individuals, thus need to account for potential correlation of behaviour among same-household individuals (i.e. intraclass correlation). One option MPlus provides for dealing with this issue is correcting standard errors (SEs); using this approach, the SEs in Tables 3 and 4 are ‘corrected’. Our approach may also have intraclass correlation among households from the same neighbourhood, indicating the need for a multilevel SEM ZINB model. We leave this approach for future research.

12. The differences may partially result from undercounting in our survey. The 55–65-year-old cohort at the time of the most recent Boston metropolitan area travel survey (in 1991) had an automobile mode share of 89 per cent (CTPS, 1993); the most recent national travel survey, although with only 194 baby boomers from the Boston MA, indicates a 78 per cent automobile mode share for all trips by this cohort (US DOT, 2009).

13. Residents of age-restricted neighbourhoods report having lived there on average for 5 years, compared with 19 years for unrestricted neighbourhoods (Hebbert, 2008).

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## Appendix

Table A1. Recreational NMT trips zero-inflated negative binomial (ZINB) model results (N = 1456)

| Model 1: ZINB without latent variables | Model 2: SEM with latent variables | Model 3: SEM with age-restricted choice model |
|----------------------------------------|------------------------------------|-----------------------------------------------|
| Logit model (zero-inflation) estimating 'likelihood of being in non-active group' | Logit model (zero-inflation) estimating 'likelihood of being in non-active group' | Logit model (zero-inflation) estimating 'likelihood of being in non-active group' |
| Age-restricted                         | Age-restricted                      | Age-restricted                                |
| Pro Walkability                        | Pro Walkability                     | Pro Walkability                               |
| Pro Segregation                        | Pro Segregation                     | Pro Segregation                               |
| Grid                                   | Grid                                | Grid                                          |
| Intersection density                   | Intersection density                | Intersection density                          |
| Facilities                              | Facilities                           | Facilities                                    |
| Destination 400                        | Destination 400                     | Destination 400                               |
| MBTA bus stop                          | MBTA bus stop                       | MBTA bus stop                                 |
| Commuter rail                          | Commuter rail                       | Commuter rail                                 |
| Street length                          | Street length                       | Street length                                 |
| Employ                                 | Employ                              | Employ                                        |
| Healthy                                | Healthy                             | Healthy                                       |
| Male                                   | Male                                | Male                                          |
| Age                                    | Age                                 | Age                                           |
| High income                            | High income                         | High income                                   |
| Mid income                             | Mid income                           | Mid income                                    |
| Three vehicles                         | Three vehicles                      | Three vehicles                                |
| Bike                                   | Bike                                | Bike                                          |
| Constant                               | Constant                            | Constant                                      |
| Coefficient                             | Coefficient                         | Coefficient                                   |
| (S.E.)                                 | (S.E.)                              | (S.E.)                                        |
| Coefficient                             | Coefficient                         | Coefficient                                   |
| (S.E.)                                 | (S.E.)                              | (S.E.)                                        |
| Coefficient                             | Coefficient                         | Coefficient                                   |
| (S.E.)                                 | (S.E.)                              | (S.E.)                                        |
| Coefficient                             | Coefficient                         | Coefficient                                   |
| (S.E.)                                 | (S.E.)                              | (S.E.)                                        |
| Coefficient                             | Coefficient                         | Coefficient                                   |
| (S.E.)                                 | (S.E.)                              | (S.E.)                                        |

Negative binomial model estimating ‘number of NMT trips among active group’

| Model 1: ZINB without latent variables | Model 2: SEM with latent variables | Model 3: SEM with age-restricted choice model |
|----------------------------------------|------------------------------------|-----------------------------------------------|
| Age-restricted                         | Age-restricted                      | Age-restricted                                |
| Pro Walkability                        | Pro Walkability                     | Pro Walkability                               |
| Pro Segregation                        | Pro Segregation                     | Pro Segregation                               |
| Grid                                   | Grid                                | Grid                                          |
| Coefficient                             | Coefficient                         | Coefficient                                   |
| (S.E.)                                 | (S.E.)                              | (S.E.)                                        |
| Coefficient                             | Coefficient                         | Coefficient                                   |
| (S.E.)                                 | (S.E.)                              | (S.E.)                                        |
| Coefficient                             | Coefficient                         | Coefficient                                   |
| (S.E.)                                 | (S.E.)                              | (S.E.)                                        |
| Coefficient                             | Coefficient                         | Coefficient                                   |
| (S.E.)                                 | (S.E.)                              | (S.E.)                                        |

(continued)
Table A1. (Continued)

| Model 1: ZINB without latent variables | Model 2: SEM with latent variables | Model 3: SEM with age-restricted choice model |
|---------------------------------------|----------------------------------|---------------------------------------------|
| Loop                                  | -0.034 (0.068)                  | -0.029 (0.068)                              | -0.029 (0.068) |
| Intersection density                  | -0.050 (0.115)                  | -0.052 (0.113)                              | -0.052 (0.113) |
| Facilities                            | 0.000 (0.066)                   | 0.010 (0.066)                               | 0.010 (0.066) |
| Destination 400                       | 0.128 (0.060)                   | 0.139* (0.060)                              | 0.139* (0.060) |
| MBTA Bus stop                         | 0.101 (0.108)                   | 0.099 (0.105)                               | 0.099 (0.105) |
| Commuter rail                         | -0.163* (0.068)                 | -0.177* (0.068)                             | -0.177* (0.068) |
| Street length                         | 0.001 (0.003)                   | 0.000 (0.003)                               | 0.000 (0.003) |
| Employ                                | -0.227** (0.055)                | -0.234** (0.056)                            | -0.234** (0.056) |
| Healthy                               | 0.065 (0.078)                   | 0.063 (0.078)                               | 0.063 (0.078) |
| Male                                  | -0.020 (0.049)                  | -0.022 (0.049)                              | -0.022 (0.049) |
| Age                                   | -0.004 (0.007)                  | -0.003 (0.007)                              | -0.003 (0.007) |
| High income                           | -0.015 (0.074)                  | -0.014 (0.074)                              | -0.014 (0.074) |
| Mid income                            | -0.035 (0.071)                  | -0.041 (0.071)                              | -0.041 (0.071) |
| Three vehicles                        | -0.038 (0.063)                  | -0.046 (0.062)                              | -0.046 (0.062) |
| Bike                                  | 0.034 (0.055)                   | 0.030 (0.055)                               | 0.030 (0.055) |
| Constant                              | 1.569** (0.422)                 | 1.552** (0.422)                             | 1.552** (0.422) |
| Alpha                                 | 0.089** (0.024)                 | 0.088** (0.024)                             | 0.088** (0.024) |

Measurement model estimating

Pro Walkability

1. I prefer to have shops and services within walking distance 1.000 (0.000) 1.000 (0.000)
2. I do not value space around my house more than shops nearby 0.889** (0.094) 0.888** (0.094)
3. I like a neighbourhood containing housing, shops and services 0.927** (0.046) 0.926** (0.046)
4. I do not prefer a lot of space between my home and the street 0.515** (0.080) 0.515** (0.080)
5. I prefer a house close to the sidewalk so that I can see passersby 0.621** (0.050) 0.620** (0.050)

(continued)
Table A1. (Continued)

|                       | Model 1: ZINB without latent variables | Model 2: SEM with latent variables | Model 3: SEM with age-restricted choice model |
|-----------------------|---------------------------------------|-----------------------------------|---------------------------------------------|
|                       | Coefficient (S.E.)                    | Coefficient (S.E.)                | Coefficient (S.E.)                          |
| **Pro Segregation**   |                                       |                                   |                                             |
| I6: I prefer neighbours at the same stage of life as me | 1.000 (0.000)                       | 1.000 (0.000)                       |                                             |
| I7: I prefer living around people who are similar to me | 0.589** (0.082)                      | 0.586** (0.081)                     |                                             |
| I8: I am concerned about strangers walking through my neighbourhood | 0.462** (0.087)                      | 0.457** (0.085)                     |                                             |
| I9: I like to live in a neighbourhood without children in it | 0.354** (0.061)                      | 0.353** (0.060)                     |                                             |
| **Structural (MIMIC) model estimating** |                                     |                                   |                                             |
| **Pro Walkability**   |                                       |                                   |                                             |
| Employ                | -0.010 (0.067)                        | -0.011 (0.068)                     |                                             |
| Healthy               | -0.024 (0.083)                        | -0.024 (0.084)                     |                                             |
| Male                  | -0.226** (0.053)                      | -0.227** (0.053)                   |                                             |
| Age                   | 0.004 (0.008)                         | 0.003 (0.008)                      |                                             |
| High income           | 0.044 (0.091)                         | 0.044 (0.091)                      |                                             |
| Mid income            | -0.094 (0.080)                        | -0.094 (0.080)                     |                                             |
| Three vehicles        | -0.301** (0.076)                      | -0.301** (0.076)                   |                                             |
| Bike                  | -0.046 (0.068)                        | -0.046 (0.068)                     |                                             |
| **Pro Segregation**   |                                       |                                   |                                             |
| Employ                | -0.167* (0.065)                       | -0.168* (0.065)                    |                                             |
| Healthy               | 0.124 (0.081)                         | 0.125 (0.080)                      |                                             |
| Male                  | 0.126* (0.049)                        | 0.126* (0.049)                     |                                             |
| Age                   | -0.001 (0.008)                        | -0.001 (0.008)                     |                                             |
| High income           | -0.030 (0.091)                        | -0.031 (0.091)                     |                                             |
| Mid income            | -0.077 (0.079)                        | -0.077 (0.079)                     |                                             |
| Three vehicles        | 0.029 (0.070)                         | 0.029 (0.070)                      |                                             |
| Bike                  | -0.128* (0.065)                       | -0.128* (0.065)                    |                                             |
| Logit model estimating ‘likelihood of choosing age-restricted neighbourhood’ | | | |
|                        | Model 1: ZINB without latent variables | Model 2: SEM with latent variables | Model 3: SEM with age-restricted choice model |
|------------------------|---------------------------------------|-----------------------------------|-----------------------------------------------|
|                        | Coefficient (S.E.)                    | Coefficient (S.E.)                | Coefficient (S.E.)                            |
| Loop                   | 5.979**                              |                                   |                                               |
| Intersection Density   | 2.206**                              |                                   |                                               |
| Facilities             | 3.393**                              |                                   |                                               |
| Destination 400        | -0.116                                | -2.647**                          |                                               |
| MBTA bus stop          |                                       | 0.199 (0.384)                     |                                               |
| Commuter rail          |                                       | 0.106**                          |                                               |
| Street length          |                                       | -0.259 (0.270)                    |                                               |
| Employ                 |                                       | 0.530 (0.340)                     |                                               |
| Healthy                |                                       | -0.442*                          |                                               |
| Male                   |                                       | 0.205**                          |                                               |
| Age                    |                                       | 1.302**                          |                                               |
| High income            |                                       | 0.470 (0.329)                     |                                               |
| Mid income             |                                       | -0.268 (0.437)                    |                                               |
| Three vehicles         |                                       | -0.323                           |                                               |
| Bike                   |                                       |                                   |                                               |
| Number of parameters   | 37                                    | 84                                | 102                                           |
| Number of observed variables | 18                                    | 27                                | 27                                            |
| Identification         | Overidentified                        | Overidentified                    |                                               |
|                        | 84 < 0.5*27*(27+1)                    | 102 < 0.5*27*(27+1)               |                                               |

Notes: † p < 0.10; * p < 0.05; ** p < 0.01.
Table A2. Social trips zero-inflated negative binomial (ZINB) model results (N = 1410)

|                                | Model 1: ZINB without latent variables | Model 2: SEM with latent variables | Model 3: SEM with age-restricted choice model |
|--------------------------------|----------------------------------------|-----------------------------------|---------------------------------------------|
|                                | Coefficient | (S.E.) | Coefficient | (S.E.) | Coefficient | (S.E.) |
| Logit model (zero-inflation) estimating 'likelihood of being in non-active group' |            |        |            |        |            |        |
| Age-restricted                 | 0.030 | (0.512) | -0.102 | (0.611) | -0.111 | (0.621) |
| Pro Walkability                | 0.043 | (0.587) | 0.400 | (0.528) | 0.399 | (0.526) |
| Pro Segregation                | -1.379 | (1.337) | -1.175 | (1.062) | -1.175 | (1.062) |
| Grid                           | 0.147 | (0.547) | 0.087 | (0.453) | 0.089 | (0.453) |
| Loop                           | -0.486 | (0.518) | -0.360 | (0.430) | -0.360 | (0.430) |
| Intersection density           | -0.395 | (0.447) | -0.217 | (0.452) | -0.217 | (0.451) |
| Pro Walkability                | 1.200† | (0.619) | 1.108† | (0.600) | 1.110† | (0.603) |
| Street length                  | 0.052 | (0.395) | 0.560 | (0.360) | 0.560 | (0.360) |
| Healthy                        | 0.370 | (0.573) | 0.374 | (0.595) | 0.374 | (0.595) |
| Male                           | 0.819* | (0.370) | 0.748† | (0.421) | 0.749† | (0.422) |
| Age                            | 0.051 | (0.48) | 0.040 | (0.045) | 0.040 | (0.045) |
| High income                    | 0.400 | (0.756) | 0.382 | (0.682) | 0.384 | (0.683) |
| Mid income                     | 0.452 | (0.600) | 0.458 | (0.602) | 0.460 | (0.605) |
| Three vehicles                 | -0.360 | (0.649) | -0.402 | (0.675) | -0.404 | (0.677) |
| Bike                           | 0.074 | (0.321) | 0.048 | (0.311) | 0.049 | (0.312) |
| Constant                       | -4.486 | (3.544) | -3.778 | (3.513) | -3.776 | (3.519) |

Negative binomial model estimating 'number of social trips among social group'

|                                | Model 1: ZINB without latent variables | Model 2: SEM with latent variables | Model 3: SEM with age-restricted choice model |
|                                | Coefficient | (S.E.) | Coefficient | (S.E.) | Coefficient | (S.E.) |
| Age-restricted                 | 0.576** | (0.212) | 0.479* | (0.239) | 0.471† | (0.242) |
| Pro Walkability                | -0.018 | (0.128) | -0.017 | (0.128) | -0.017 | (0.128) |
| Pro Segregation                | 0.156 | (0.111) | 0.156 | (0.110) | 0.156 | (0.110) |
| Grid                           | 0.115 | (0.196) | 0.046 | (0.202) | 0.046 | (0.201) |
Table A2. (Continued)

| Model 1: ZINB without latent variables | Model 2: SEM with latent variables | Model 3: SEM with age-restricted choice model |
|--------------------------------------|----------------------------------|--------------------------------------------|
| Loop                                 | Coefficient (S.E.)              | Coefficient (S.E.)                         | Coefficient (S.E.)          |
| Intersection density                 | −0.157 (0.200)                  | −0.182 (0.184)                             | −0.180 (0.184)              |
| Facilities                            | −0.188 (0.186)                  | −0.244 (0.273)                             | −0.242 (0.273)              |
| Destination 400                       | 0.142 (0.173)                   | 0.196 (0.195)                              | 0.196 (0.195)               |
| MBTA bus stop                         | −0.659 (0.481)                  | −0.603 (0.595)                             | −0.603 (0.593)              |
| Commuter rail                         | 0.342* (0.167)                  | 0.352† (0.182)                             | 0.353† (0.182)              |
| Street length                         | −0.008 (0.007)                  | −0.009 (0.006)                             | −0.009 (0.006)              |
| Employ                                | −0.368* (0.168)                 | −0.327* (0.151)                            | −0.327* (0.151)             |
| Healthy                               | −0.006 (0.187)                  | −0.006 (0.189)                             | −0.006 (0.189)              |
| Male                                  | 0.144 (0.154)                   | 0.144 (0.153)                              | 0.145 (0.152)               |
| Age                                   | 0.048* (0.020)                  | 0.043* (0.020)                             | 0.043* (0.020)              |
| High income                           | −0.262 (0.268)                  | −0.259 (0.253)                             | −0.258 (0.254)              |
| Mid income                            | −0.155 (0.198)                  | −0.126 (0.207)                             | −0.125 (0.207)              |
| Three vehicles                        | −0.185 (0.244)                  | −0.194 (0.261)                             | −0.195 (0.261)              |
| Bike                                  | 0.262* (0.133)                  | 0.261* (0.131)                             | 0.262* (0.131)              |
| Constant                              | −2.518† (1.285)                 | −2.243† (1.319)                            | −2.241† (1.320)             |
| Alpha                                 | 0.360† (0.215)                  | 0.301 (0.200)                              | 0.301 (0.201)               |

Measurement model estimating Pro Walkability

I1: I prefer to have shops and services within walking distance
I2: I do not value space around my house more than shops nearby
I3: I like a neighbourhood containing housing, shops and services
I4: I do not prefer a lot of space between my home and the street

| I1 | Coefficient (S.E.) | Coefficient (S.E.) | Coefficient (S.E.) |
|----|---------------------|---------------------|---------------------|
|    | 1.000 (0.000)       | 1.000 (0.000)       | 1.000 (0.000)       |
| I2 | 0.893** (0.093)     | 0.893** (0.093)     | 0.893** (0.093)     |
| I3 | 0.929** (0.045)     | 0.929** (0.045)     | 0.929** (0.045)     |
| I4 | 0.520** (0.080)     | 0.520** (0.080)     | 0.520** (0.080)     |
| Coefficient (S.E.) | Coefficient (S.E.) | Coefficient (S.E.) |
|---------------------|---------------------|---------------------|
| **I5**: I prefer a house close to the sidewalk so that I can see passersby | 0.625** (0.051) | 0.625** (0.051) |
| **Pro Segregation** | | |
| **I6**: I prefer neighbours at the same stage of life as me | 1.000 (0.000) | 1.000 (0.000) |
| **I7**: I prefer living around people who are similar to me | 0.593** (0.085) | 0.588** (0.084) |
| **I8**: I am concerned about strangers walking through my neighbourhood | 0.465** (0.090) | 0.459** (0.088) |
| **I9**: I like to live in a neighbourhood without children in it | 0.354** (0.060) | 0.352** (0.060) |

**Structural (MIMIC) model estimating Pro Walkability**

| Coefficient (S.E.) | Coefficient (S.E.) | Coefficient (S.E.) |
|---------------------|---------------------|---------------------|
| **Pro Walkability** | | |
| **Employ** | −0.010 (0.067) | −0.010 (0.067) |
| **Healthy** | −0.024 (0.083) | −0.024 (0.083) |
| **Male** | −0.226** (0.053) | −0.225** (0.053) |
| **Age** | 0.004 (0.008) | 0.003 (0.008) |
| **High income** | 0.044 (0.091) | 0.044 (0.091) |
| **Mid income** | −0.093 (0.079) | −0.093 (0.079) |
| **Three vehicles** | −0.300** (0.076) | −0.300** (0.076) |
| **Bike** | −0.046 (0.067) | −0.046 (0.067) |

| Coefficient (S.E.) | Coefficient (S.E.) | Coefficient (S.E.) |
|---------------------|---------------------|---------------------|
| **Pro Segregation** | | |
| **Employ** | −0.167* (0.065) | −0.168* (0.065) |
| **Healthy** | 0.124 (0.081) | 0.124 (0.081) |
| **Male** | 0.126* (0.049) | 0.126* (0.049) |
| **Age** | −0.001 (0.008) | −0.001 (0.008) |
| **High income** | −0.031 (0.091) | −0.031 (0.092) |
| **Mid income** | −0.078 (0.079) | −0.078 (0.079) |
| **Three vehicles** | 0.029 (0.070) | 0.029 (0.070) |
| **Bike** | −0.128* (0.064) | −0.128* (0.065) |

(continued)
### Table A2. (Continued)

|                      | Model 1: ZINB without latent variables | Model 2: SEM with latent variables | Model 3: SEM with age-restricted choice model |
|----------------------|----------------------------------------|-----------------------------------|---------------------------------------------|
|                      | Coefficient (S.E.)                     | Coefficient (S.E.)                | Coefficient (S.E.)                          |
| Logit Model Estimating ‘Likelihood of choosing age-restricted neighbourhood’ | | | |
| Pro Walkability      | 0.138 (0.180)                          | 0.815** (0.148)                   |                                              |
| Pro Segregation      | 5.982** (0.708)                         | 2.205** (0.384)                   |                                              |
| Loop                 | 3.397** (0.341)                         | 0.112 (0.300)                     | -2.641** (0.940)                            |
| Intersection density | 0.196 (0.432)                           | 0.106** (0.014)                   |                                              |
| Facilities           | -0.261 (0.270)                          | 0.529 (0.340)                     |                                              |
| Destination 400      | -0.112 (0.300)                          | -0.445* (0.192)                   |                                              |
| MBTA bus stop        | 0.196 (0.432)                           | 0.106** (0.014)                   |                                              |
| Commuter rail        | 0.196 (0.432)                           | 0.106** (0.014)                   |                                              |
| Street length        | 0.106** (0.014)                         | 0.106** (0.014)                   |                                              |
| Employ               | -0.261 (0.270)                          | 0.205** (0.037)                   |                                              |
| Healthy              | 0.529 (0.340)                           | 1.303** (0.397)                   |                                              |
| Male                 | -0.445* (0.192)                         | 0.205** (0.037)                   |                                              |
| Age                  | 0.205** (0.037)                         | 1.303** (0.397)                   |                                              |
| High income          | 0.467 (0.329)                           | 0.467 (0.329)                     |                                              |
| Mid income           | -0.266 (0.436)                          | -0.266 (0.436)                    |                                              |
| Three vehicles       | -0.321 (0.267)                          | -0.321 (0.267)                    |                                              |
| Bike                 |                                        |                                   |                                              |
| Number of parameters | 37                                      | 84                                | 102                                          |
| Number of observed variables | 18                                      | 27                                | 27                                           |
| Identification       | Overidentified                          | Overidentified                    |                                              |
|                      | 84 < 0.5*27*(27+1)                      | 102 < 0.5*27*(27+1)               |                                              |

**Notes:** † p<0.10; * p<0.05; ** p<0.01.