4 Varying Neighbourhood "Choice Architecture": Exploiting behavioral economics in urban form to achieve further emissions reductions

Chapter Summary

When evaluating the factors of urban form that contribute to emissions, we must also consider the difficult but critical subject of human behaviour and choices of consumption. There is indeed a body of research findings that gives us guidance on the "choice architecture" of neighbourhood design. This chapter examines the evidence and draws conclusions for the decision support tool.

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One of the promising topics of investigation into GHG mitigation has been the opportunity to achieve significant reductions through changes in behavior and consumption, with a notable focus on the household scale (Gowdy, 2008; Dietz et al., 2009). This work is informed by new developments in the field of behavioral economics, and, as we discuss in more detail below, the topic of "choice architecture" – the effect that transparent changes in the structure of choices can have on behavior (Thaler, Sunstein and Balz, 2010, Kahneman, 2002). It seems that the pre-arrangement of choices can, without necessarily *removing* choices, have a marked effect on the actual choices made – and as a consequence, on GHG emissions.

We investigate here the same question at the neighbourhood scale. That is, can feasible changes to the "choice architecture" of neighborhoods – that is, of urban design – offer an additional strategic pathway to achieve significant reductions in per-capita GHG emissions? If so, the implications could be far reaching, and extend beyond the topic of GHG mitigation to include other social policy goals and strategies. Our investigation concludes in the affirmative – although we note that this is an early finding, and significant further development awaits.

§ 4.1 Methodology

One method to conduct the investigation would be to perform detailed comparative experiments on various features and their effects on demand behaviours. Further regression and hedonic analyses could be performed to tease out the factors and draw conclusions. This research methodology is common in economic analysis of buyer preferences and the like.

The drawback of this approach is that any one study is likely to paint a very limited, context-dependent picture. Given the complexity of the local variables that may skew results, it is only when a significant body of literature has been developed that reliable general conclusions can likely be drawn, sufficient to guide modelling tools in design practice (the goal herein).

Another approach is to survey the literature of existing studies on resident behaviours relative to consumption patterns – particularly those affecting travel modes and other potentially high-consumption activities – and to re-interpret them through the lens of choice architecture, drawing potentially useful conclusions about new strategies. Subsequently these conclusions can be further evaluated through more direct empirical studies.

Accordingly, we survey a number of topics relative to neighbourhood consumption patterns, and the findings of previous peer-reviewed research. We assess the results through the lens of choice architecture, allowing us to draw conclusions about likely tools and strategies for relatively non-controversial changes in demand. We conclude with a discussion of the incorporation of tools and strategies into revised urban design models, as a basis for updated best practice.

§ 4.2 The controversy over urban-scale mitigation actions

We must start by noting that debate has raged over the potential magnitude of GHG reductions that are actually available from variations in urban form. In one well-known example, a paper published by the National Academy of Sciences (2009) argued that the individual factors that can be varied are not significant contributors in themselves, and that, because urban form changes slowly, meaningful GHG reductions from changes in urban form are not available in the short term.

However, a rebuttal by Ewing et al. (2011) argued that the individual magnitudes were under-stated in the NAS paper, and that their significant cumulative effects were ignored. Other research (summarized by Mehaffy, 2013) also supported the view that, taken together, the factors of urban form account for very large variations indeed in per-capita GHG emissions – up to 30% or more. Furthermore, while changes in urban form do indeed occur slowly, the corollary is that they are long-lasting. If they do generate large variations in emissions, then it matters even more, over longer spans of time, what characteristics of urban form we choose.

But the relationship between variations in demand and changes to urban form remains a topic for deeper investigation. For example, do people tend to choose to drive more in some neighborhoods with certain characteristics of form, all other things held equal? Do they choose to consume more energy-intensive, high-emissions products?

We already know from other forms of intervention that demand can be a problematic variable. For example, the actual performance of many energy-efficient buildings has been shown to deviate substantially from predicted levels, in part because of variations in anticipated demand (Newsham and Birt, 2009, Montanya and Keith, 2011).

As discussed previously, the problem is especially acute because demand is an elastic variable, subject to the phenomenon known as "induced demand." While other variables are optimized, demand can increase significantly as a consequence, erasing the benefits of efficiencies. In transportation, the phenomenon can be seen when widening of roads draws more drivers, eventually eroding the mobility benefits of the widening.

Merely making a technology more resource-efficient can also result in induced demand. As we discussed in the last chapter, an example is the variation known as Jevons' Paradox, which observes that as efficiency goes up, cost tends to go down, which tends to result in increased consumption demand. This phenomenon has been observed as an unintended consequence of increased energy efficiency (Polimeni, 2008). The result is an unexpected increase in emissions, relative to what would be expected.

The actual magnitude of Jevons' Paradox and related effects has been the subject of significant controversy in the field of energy-efficient technology (e.g. see Sorrell, 2009). But the principle has been widely established in the economics literature since economist William Stanley Jevons first observed it in 1865, and it illustrates a wider challenge for GHG reduction. Consumption demand is a crucial variable that can greatly distort or even erase achievements from other efforts, including narrow technological responses. It follows that we must take a comprehensive approach to greenhouse gas reductions, along with the other beneficial outcomes we seek in neighbourhood design.

In order to find effective methods to confront the challenge of consumption demand head-on, we must look for the behavioral factors that shape it more directly.

§ 4.3 "Choice Architecture" in Behavioral Economics

In recent years the field of economics has increasingly turned to psychology to explain behaviours that are not predicted by standard economic models, notably by the "efficient market hypothesis" (Sent, 2004; Wilkinson, 2008). That is, human beings often make choices that are based on limited information, and limited ability to make rational judgments – a condition termed "bounded rationality" by the economist and psychologist Herbert Simon (1956). The result is that choices are distorted by the limits of human cognition – limits that, according to Simon, often have their origin in the structure of the environment and the psychology of its experience.

Building on that key insight, the concept of "choice architecture" was introduced in 2008 by behavioral economists Richard Thaler and Cass Sunstein (Thaler, Sunstein and Balz, 2010) to describe the influence on decision-making of the predetermined structural configuration in which choices occur. The clear implication is that alterations in that structure may alter the outcomes of decision-making. Since its introduction, work on the topic to date has focused on the intersection of consumer behavior and public policy, e.g. choices for healthy eating (Johnson et al., 2012).

From a more pragmatic perspective, commercial businesses have already compiled an extensive body of knowledge about the factors that influence consumer behavior in retail environments, including visibility and access from the street (Gibbs, 2011). While this research does not focus on "choice architecture" by name, it examines the same kinds of questions: for example, what placement of signage, window displays, driveway access and other factors is most likely to encourage patronage? What is most likely to discourage patronage, and reduce likelihood of success in a given location?

It is not a major leap to investigate the next question: what placement of neighbourhood elements will influence consumption behavior, and in what ways? How can we, as choice architects, make changes to those placements so as to affect consumption behavior? Here we begin to suggest a set of likely topics for preliminary use in modelling of urban design strategies.

§ 4.4 Choice Architecture and Transportation Behaviour

There is a mature body of research documenting the contribution of vehicular transport (notably personal automobile transport) as a significant factor in global per-capita GHG emissions, particularly so in developed countries (Dodman, 2009). This factor appears likely to gain in significance as countries like China and India continue to develop car-dependent urban forms (Calthorpe, 2013). To the extent that the "modal split" (the percentage using different forms of travel) can be shifted away from vehicle use and towards walking and/or bicycling, there is a concrete opportunity to achieve measurable reductions in energy and resource consumption, and in GHG emissions per capita, in combination with other opportunities (Pacala and Socolow, 2004).

This opportunity appears especially attractive because walking or bicycle transportation requires minimal energy and resources – largely limited to the food that a walker or bicyclist consumes – whereas single-occupant automobiles traveling over the same distance can consume as much as 250 ml of motor spirit per kilometer, and emit up to 600g of greenhouse gas per kilometer as well as other pollutants. (Other modes, such as public transit and car sharing, generally consume fewer resources per kilometer than single-occupant automobiles, though they are higher than walking and bicycling.)

In addition, the embodied energy and materials in automobiles and infrastructure further increase the average emissions per unit of distance (Mehaffy, 2013). This is because greater vehicle operation and Vehicle Miles Travelled (VMT) on average requires manufacture of a greater number of automobiles, and more construction, maintenance and operation of roadways, all of which contribute to resource consumption and GHG emissions. In addition, roadways and other infrastructure generally remove vegetation and pervious cover, further exacerbating the problem.

Therefore, if changes to neighbourhood choice architecture can have a significant effect on modal split, then such a strategy may assist with achieving significant per-capita reductions of GHG emissions as well. But before we can examine changes, we must assess the choice architecture of existing neighborhoods and the places where changes might be made.

There is a growing body of evidence showing that the basic features of neighbourhood form do affect choice of transportation mode. Jiao, Moudon and Drewnowski (2011) showed that greater distance between retail and employment destinations was strongly correlated with a greater mode share of automobiles (in addition to longer trips, by virtue of the greater distance). Other elements of choice architecture also tended to increase modal split in favour of automobiles, including the presence of larger parking lots at grocery stores, lower density of streets, and percentage of single-family homes (Ibid.).

Krizek (2013) also showed that neighbourhood form is correlated with changes in travel behaviour for new residents moving into a neighbourhood. This is an important finding in that it excludes demographic characteristics per se, and demonstrates that neighbourhood form alone does have an influence on transportation behaviour.

Following is a more detailed examination of the choice architecture of various neighbourhood types, and their specific characteristics of choice architecture.

§ 4.5 Choice Architecture in Auto-Dependent Neighbourhoods

We begin with a common development type in affluent countries: neighborhoods in which most trips, by virtue of the neighbourhood design, must occur by automobile. The density may be too low to support public transit, destinations may be too far to be practical for walking or biking, and other provisions for walking or biking may not exist. (We consider these features in more detail in the next section.) We refer to these neighborhoods as "auto-dependent" in that residents must depend upon automobile transportation for essential trips.

First, we need to investigate what choice architecture is created by the automobile itself, once it is in use. The most obvious is the capacity to continue driving for longer distances, and the often cumbersome disincentive to stop the car and switch to other modes of transportation. The latter requires identifying an appealing mode of alternative transportation, finding a space in which to park the car, going through the process of manoeuvring the car, and finally unbuckling, exiting and securing the car – all of which take considerably more effort than remaining in the car. The bias toward operating the car is thus a form of "induced demand" that can result in increased VKT and increased fuel consumption and emissions, along with other factors.

The economic literature provides evidence of this phenomenon at work. In work on the effect of "search costs" (Smith, Venkatraman and Dholakia, 1999) it was shown that consumers may not have adequate information about the full costs versus benefits of continuing a "search" (e.g. pursuing an alternative mode or destination) and may therefore default to the current choice. This is a manifestation of the phenomenon of bounded rationality noted by Simon (1956).

The phenomenon of "switching costs" in economics carries a similar implication: the costs of time and opportunity in searching for parking, manoeuvring and securing the car are known, whereas the benefits of making the switch are unknown, with the result that the switch is less likely (Dobbie, 1968). The result may well be that a driver will make what in retrospect appears to be an apparently irrational decision to drive to a store that offers cheaper products, even though the cost of the fuel burned may be even greater than the savings. In the terms of this analysis, the driver's rationality is "bounded" by the choice architecture of the environment.

In addition, it is evident that automobiles also create a choice architecture that greatly limits social interaction with others encountered during the trip. There are findings that suggest that this reduced interaction affects not only the trip itself, but overall levels of social interaction for neighborhoods in which a greater percentage of trips occurs by automobile (Nasar, 1997; Freeman, 2001; Leyden, 2003). This may be because of the cumulative effect of frequent trips by automobile (although more work needs to be done on this question).

Secondly, we can ask what choice architectures are created within the infrastructure system that is designed to accommodate the automobile: the service station convenience stores, drive-in fast-food restaurants, drive-to shopping centres, and other related facilities. It is perhaps not surprising that they exploit the opportunity to present high-consumption choices to a captive market, using sophisticated behavioral psychology to do so (Smith, 2004; Chandon and Wansink, 2010).

Lastly, we can ask what is the unintended choice architecture of a car-dependent neighbourhood on other modes of transportation. There is ample evidence that the engineering changes needed to accommodate automobiles can (and often do) conflict with the safety and comfort of pedestrians and bicyclists (Pucher and Dijkstra, 2003). In turn, there are negative impacts on public transit users, who must walk or bike to and from transit stops. This negative impact increases with the degree of car dependency and use, resulting in an increasingly dangerous and uncomfortable environment for non-auto users.

Put differently, the findings demonstrate that auto dependency tends to produce more auto dependency, within a feedback cycle. The cycle is accelerated via the reinforcing influences of a changing neighbourhood choice architecture.

§ 4.6 The choice architecture of walkable and bikeable neighborhoods

At the other end of the transport consumption spectrum, the literature also helps us to identify elements of a neighbourhood choice architecture that influence rates of walking and biking. There is evidence that neighborhoods with higher rates of walking and biking exhibit trip-substitution from longer-distance automobile travel (Ewing and Cervero, 2001). This in turn implies reduced GHG emissions per capita, an implication that is supported by other studies on city GHG emissions (Ewing et al., 2008; Cervero and Murakami, 2010). It thus appears that increasing walking and biking trips is an attractive "stabilization wedge" in GHG reduction strategies (Pacala and Socolow, 2004) and an attractive target for a choice architecture strategy.

As might be expected, research has demonstrated higher rates of walking in neighborhoods with more walkable design, even adjusting for other factors such as self-selection (Frank et al., 2007). In particular, the literature shows a strong correlation between rates of walking and short blocks with high intersection density (Leslie et al., 2005, Berrigan, Pickle and Dill, 2010). As the investigators note, short blocks lessen the average distance between any two destinations, making walking a more attractive choice. In addition, shorter blocks present a more varied and visually interesting walking path, with more frequent changes of vistas, as compared to longer, unbroken blocks. At the opposite extreme, so-called "dendritic" street patterns can make walking nearly impossible because of the excessively long, indirect paths for most trips (Figure 4.1).

Short blocks and high intersection densities are also associated with greater rates of bicycle use, for the same evident reasons (Winters et al., 2003). A "permeable" street network shortens average trip distances, and also gives bicycle users a greater opportunity to use alternate streets that are safer and with less traffic. Moreover, such a permeable network is likely to reduce the concentrations of traffic overall, and reduce the number of areas of dangerous traffic with which a bicycle might have to contend – particularly if secondary streets can be used for bicycles (Mehaffy et al., 2010).

Another evident factor is the provision of well-designed pavements (also known as sidewalks in the USA) and bicycle lanes. Nelson and Allen (1997) showed that there is a correlation between the total length of lanes and the rates of bicycling. Cao, Mohktarian and Handy (2007) showed a relation between safe and well-designed pavements and bike lanes, and increased rates of walking and biking with reduced rates of driving. It seems probable that these well-designed systems shift the choice architecture for residents towards changes in travel behavior.

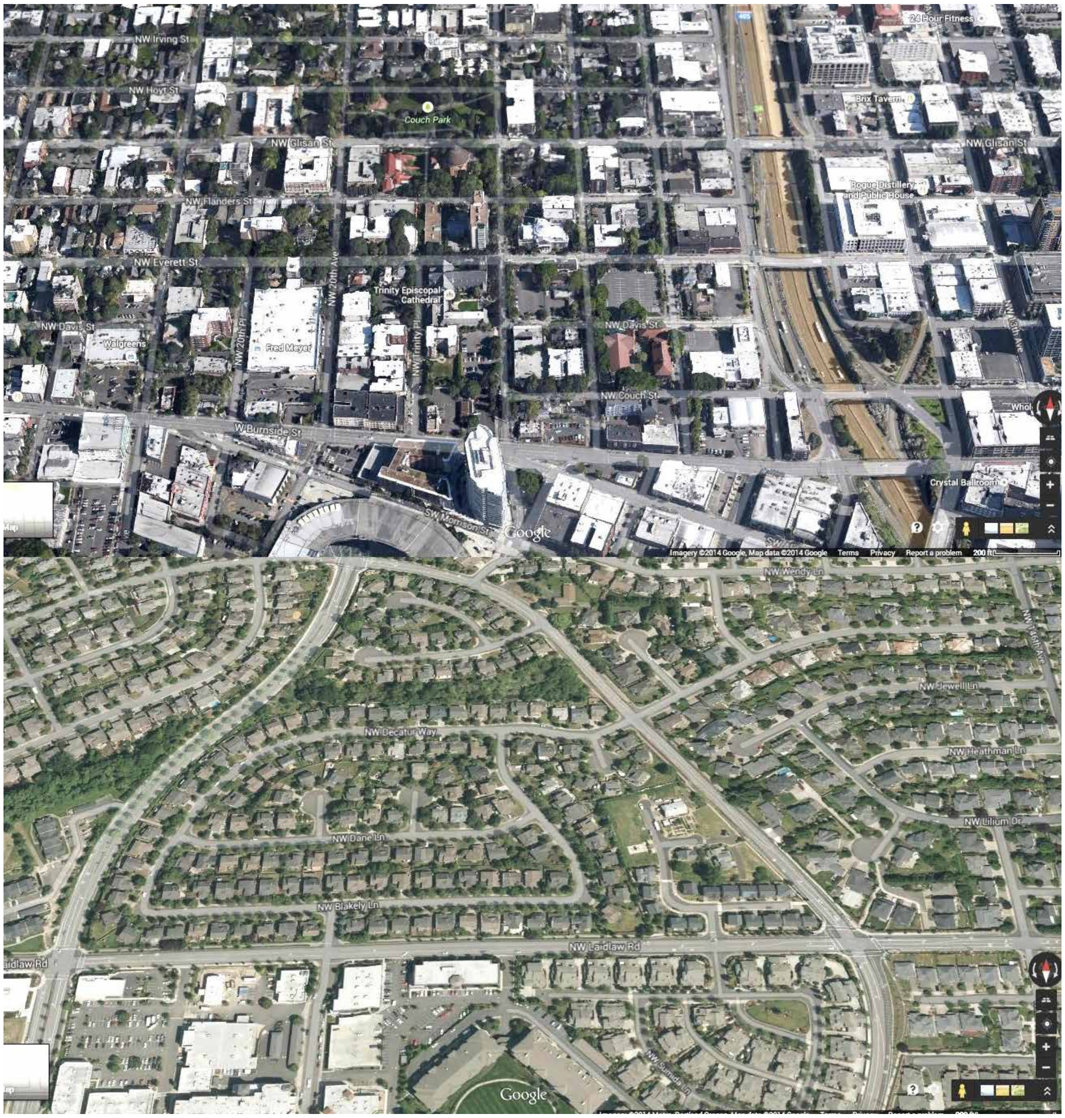

FIGURE 4.1 Two very different street patterns shown at the same scale. Above, short blocks and a high density of intersections invites walking, and allows combined trips. The highway is not allowed to sever the walkable fabric; instead it is submerged below bridges that continue the walkable street grid. Below, long uninterrupted blocks and "dendritic" or tree-like street patterns make walking unappealing and difficult for most trips, resulting in greater numbers of longer, point-to-point driving trips. Photo Credit: Google Maps..

Another important component is the aesthetic character of the streetscape itself, including vegetation, interesting small-scale details, mix of uses and activities, and user experiences of beauty. Cerin et al. (2006) showed that the presence of vegetation is associated with greater walking. Other investigators found similar results for both walking and biking (Saelens, Sallis and Frank, 2003, Wahlgren and Schantz, 2012). Wahlgren and Schantz (2012) also found that user experiences of beauty and greenery both served independently as stimulating factors for bicycle commuting. This finding suggests that beauty in buildings (as experienced by users) as well as natural areas can improve the choice architecture to favour bicycle use.

Of course, the question of what specific design characteristics a walker or bicyclist is most likely to find beautiful must also be ascertained, and this research is not mature. But Cold (1998) surveys literature concluding that such environmental preferences are not subjective but are rooted in evolutionary history. In particular, the perception of beautiful environments is strongly associated with environments that combine coherence with complexity. This combination affords curiosity, enticement and an opportunity to penetrate hidden layers. Neighborhoods with these factors are indeed associated with measurably higher rates of walking and bicycling (Saelens, Sallis and Frank, 2003).

§ 4.7 The choice architecture of public transit use

Through this lens, we can also ask what are the characteristics of neighbourhood choice architecture that will tend to encourage public transit use. To the extent such use displaces equivalent trips by automobiles on an equal basis, there is strong evidence that it results in lower per capita GHG emissions (Poudenx, 2008; Mehaffy, 2013). We will not consider here the many factors relating to transit frequency, connected destination network and other factors that are within the control of the transit service management. Rather, we consider what factors within the neighbourhood itself might encourage transit use.

Foremost among them is the walkability or bikeability of pathways to transit stops, which will affect the willingness of residents to make the initial journey to the transit stop (Frank and Pivo, 1994; Cervero and Radisch, 1996). Closely related to this factor is the distance to the transit stop from an average point of origin (Zhao et al., 2003).

A second factor affecting transit use is the attractiveness and comfort of the transit vehicles and facilities themselves. Although this factor is often overlooked, it seems likely that a part of the relative stigmatization of bus travel in particular is in its aesthetic character, and the identity it carries of a "second-class" form of transportation (Audirac and Higgins, 1984; Poudenx, 2008).

Lastly, there is evidence that the immediate environment of the transit stop is important. If it contains other adjacent uses – particularly services that are likely to attract waiting passengers – it is likely to be more frequented (Schmenner, 1976; Kim, Ulfarsson and Hennessy, 2007). In addition, if there is shelter from inclement weather, this amenity signals to potential riders that they will be comfortable while awaiting their transport (Law and Taylor, 2001).

As in other areas, these findings lend support to the concept that modifications to the choice architecture of a neighbourhood can have substantial impacts on the actual choices made to use public transit.

§ 4.8 The choice architecture of neighbourhood housing types

The design of neighborhoods inevitably affects and limits the design of housing, including the size of lots, the configuration of attached housing, and less directly, the size of homes. In turn, these structures present a choice architecture to residents that, as evidence discussed below will suggest, greatly affects domestic consumption patterns.

First, there is evidence that the size of homes and lots plays a major role in consumption demand (Ewing and Rong, 2008). Aside from the obvious reduction of space required to heat, cool and light the home, residents also have more limited choices to purchase high-consumption household and backyard goods. Residents who "downsized" homes do have a lower demand profile (Erickson, Chandler and Lazarus, 2012).

A second, related finding is that residential water use is notably lower in more compact neighborhoods (Chang, Parandvash and Shandas, 2010; House-Peters and Chang, 2010). By contrast, larger-lot suburban residents may experience reinforcement of attitudes and behaviours associated with high water consumption (Corbella and Pujol, 2009). This water use disparity carries implications for GHG emissions in two respects: one, the water itself requires energy and other resources for pumping, storing and purifying; and two, the rates of water use tend to closely track rates of energy used in water heating, clothes washing, lawn care and other household activities.

The analysis of geographic data on energy and resource consumption shows striking patterns of variation, but more work is needed to integrate models of household sources of consumption in relation to regional sources of production (Baynes et al., 2011). For now it seems very likely that the home itself creates a choice architecture favouring greater per capita consumption and greater GHG emissions (Høyer and Holden, 2003). In turn neighbourhood form creates the context in which household-scale choice architecture occurs.

§ 4.9 The choice architecture of recreational activities

In addition to its evident health benefits, active outdoor recreation is a low-carbon activity in relation to other activities that it typically replaces – for example, sedentary consumption activities within the home. If outdoor recreation is within walking distance to the home, there is reason to hypothesize that walking trips to recreation may also replace longer trips by vehicle, possibly to other higher-GHG emitting activities. But at present this is an immature topic needing further development.

It also seems clear that the presence of nearby parks, in addition to making convenient recreation available, may also provide a choice architecture in which residents are more likely to engage in park use activities (Groth et al., 2008). Conversely, the absence of such facilities within the neighbourhood, even when residents have the means to access more distant ones readily by vehicle, is associated with lower active recreation by residents (McCormack et al., 2010).

§ 4.10 The choice architecture of food consumption

There is evidence that the structure of a neighbourhood has a notable influence on the pattern of food consumption by residents. In turn there are implications for resource intensity of the food consumed, the amount of waste packaging, and contributions to landfills – all of which drive greenhouse gas emissions per capita.

Neighbourhoods whose choice architecture favours driving can create a "cycle of dependence" (Handy, 1993) in which smaller, more local retail is replaced with more distant regional "volume" shopping centres, along with "big box," fast-food and other "drive through" convenience retailers. These facilities benefit from a captive automobile-based market, in the form of buyers who must, if they are not satisfied with the selection, go to the trouble of returning to their automobiles and initiating the cumbersome process of driving to another facility. For this captive market, businesses have become adept at utilizing brightly coloured packaging and signage, and high concentrations of salt, fat, sweets and processed foods, which entice buyers to engage in high-consumption purchases (Smith, 2004, Chandon and Wansink, 2010).

Another example of negative neighbourhood choice architecture is a lower-income neighbourhood that does not have any reasonable access to affordably priced healthy food outlets for its residents. Such a "food desert," as it has been called, is associated with poorer diets and lower measures of health (Wrigley et al., 2002). Many residents of such neighborhoods have been observed to shift to higher consumption of so-called "junk foods," including more resource-intensive foods sold at drive-in fast-food and service station convenience store outlets (Walker, Keane and Burke, 2010).

As an alternative, Larsen and Gilliland (2009) report that adding farmers' markets to such food deserts resulted in measurable declines in the cost of foods overall, and increases in the consumption of healthy foods. Younger et al (2008) found that farmers' markets "ease the burden of food production on GHG emissions by decreasing the distance goods are transported and the demand for deforestation."

We can also see examples of positive choice architecture in sidewalk-facing markets that present appetizing healthy food in a way that is visible to pedestrians and bicyclists, creating a very different choice architecture (Figure 4.2). Of course it is possible to present unhealthy foods in the same way, but it is notable that the close proximity of the food to pedestrians and bicyclists in effect "levels the playing field" and allows fresh fruit and produce to be shown in a most appealing way.

FIGURE 4.2 The choice architecture of a street in Oslo, Norway. The neighbourhood form facilitates choices of walking, multi-modal transport, healthy and relatively low-emission foods, and combined trips. Photo Credit: Author.

§ 4.11 Several methodological and ethical questions

Before we can proceed with a strategy to implement the tools of choice architecture at the neighbourhood scale, we must ask several key questions regarding the validity of the analysis presented herein.

One, how do we know that the gains in choice architecture in one area will not be offset or even overtaken by losses in other areas of behavior? For example, there has been criticism that the relative low-carbon lifestyle of urban residents is offset by their demand for externalities such as foreign-manufactured products, or by other activities such as jet travel.

The answer is that we must always operate, as much as possible, on a per-capita, apples-to-apples basis. While it may be the case at any time that individuals engage in new activities and new demands that offset the reductions achieved in other activities, the question is always whether the other activities *in themselves* are creating induced demand, or whether they would otherwise create additional consumption if the mitigating actions did not take place.

Another question regards whether we can focus effectively on greenhouse gas reductions while ignoring other needs and priorities, such as community health and well-being. Can we avoid creating unintended effects with such a narrow focus? The answer, of course, is that we can't, and furthermore, it is perfectly possible to achieve multiple objectives with a comprehensive approach to neighbourhood form, as a number of investigators have demonstrated (e.g. Younger et al., 2008).

It is equally important to recognize a looming question in this assessment: on what basis are neighbourhood "choice architects" any more suited to judge the choices that are desirable, than the citizens who are making decisions about the course of their own lives -- however flawed we may judge those decisions to be? This question was notably raised by Selinger and Whyte (2010) and as they noted, it raises a core methodological issue of the competence of planners and urban designers to make decisions on behalf of others. For example, even if we agree that the pursuit of greenhouse gas reductions is a laudable goal, how can we trust urban choice architects not to create other unintended and sometimes deleterious effects on the well-being of residents?

This question was also considered earlier by Kevin Lynch (1984). He argued that norms of good and bad are an inevitable ingredient of planning and design decisions. That is, it is of the essence of such decisions that some people are making choices on behalf of others. What is vital, Lynch argued, is that these processes are transparent, and that the normative theories behind them are explicit, so that they can be evaluated within a democratic and professionally accountable process. When such values lie unexamined, he argued, they are dangerous.

In that sense, the test for an urban choice architecture lies in whether or not it serves to achieve the values that the community itself has defined in its pursuit of its well-being *as a whole,* as opposed to the values that various sub-groups have defined in their own interest, be they professional, economic or otherwise. In that sense, urban choice architecture is no different than any other aspect of urban design: there is a professional responsibility of transparency, accountability, and democratic review.

§ 4.12 Conclusion

We can now summarize, for the purposes of this exploratory assessment, the identified elements of a neighbourhood choice architecture suitable for a GHG reduction strategy (without limiting such a strategy from the pursuit of other goals and benefits). We also list in parentheses the specific factor that contributes to GHG reduction, as shown by the cited research discussed above.

1. A tightly connected street network, utilizing relatively small blocks (increased walkability, bikeability).
2. Beautiful streetscapes, defined according to user preferences (increased walkability, bikeability).
3. Safe routes, free from vehicular danger (increased walkability, bikeability).
4. Visually appealing transport stops, offering services and/or shelter (increased public transport use).
5. Visually appealing transport vehicles, offering dignified and comfortable transport (increased public transport use).
6. Close proximity to active recreation areas (decreased indoor consumption activities).
7. Close proximity to healthy and local food outlets, with active streetfront displays (decreased consumption of high-embodied energy and processed foods).

It is worth noting that, apart from a GHG reduction strategy, many of these elements offer evident benefits on their own, and few are in themselves politically controversial, or inconsistent with market demand for neighbourhood amenities. (They may however be inconsistent with some developer biases.) These findings do suggest that a neighbourhood choice architecture strategy can be entirely consistent with open, democratic and politically feasible neighbourhood planning models.

How can we get an assessment of the possible per-capita GHG emissions reductions available from the implementation of such a choice architecture? Of course the implementation would necessarily be slow, but as we noted previously, the corollary is that its effects would be persistent and cumulative. One way to gauge the potential magnitude of reductions is to compare existing neighborhoods with and without the features, and – excluding other identifiable factors as much as possible – to examine the variations in their per-capita emissions.

Indeed, we find quite dramatic differences in per capita emissions in different cities and countries around the world, as described in the introduction section of this dissertation (World Bank, 2011; Olivier, et al., 2013). The enormous variation in GHG emissions per capita – up to a five-fold difference or more – is currently not explainable by common factors such as a warm climate or an impoverished economy (as can be seen with cities like, say, Stockholm). A behavioral model does point a strong finger of suspicion at the variations in behavioral choices created by urban form.

In fact an examination of the urban form of places like Stockholm does reveal a structure of relatively small blocks, with beautiful, safe walkable streetscapes, attractive transport facilities, well-distributed recreational spaces, proximity to healthy food choices, and relatively small homes, including a high percentage of attached homes.

What percentage of the reductions might be attributable to this difference in choice architecture per se? It is of course difficult to isolate those factors from the other factors with which they interact. But on the basis of the enormous difference from urban form, and the known effects of behavior on emissions, we believe it is reasonable to start with a hypothesis that at least ten percent reduction is possible, perhaps more, as a starting point for further investigation.

Of course this is only a conceptual evaluation, and more detailed comparative research needs to be done. Given the variability of demand and its sensitivity to other factors, this is likely best done within specific local studies and pilot projects that must be part of a larger process of iteration and learning. But we believe we can identify sufficient support in the literature for the GHG reduction benefits of each of these choice architecture factors, at a level that is already sufficient to motivate experimental implementation in policy and practice.

FIGURE 4.3 An inviting, walkable pathway leading to convenient, attractive public transit. Photo: the author.

References

Audirac, I. and Higgins, H. (2004). *From Bus Shelters to Transit-Oriented Development: A Literature Review of Bus Passenger Facility Planning, Siting, and Design.* Tallahassee FL: Florida State University, Florida Planning and Development Lab.

Baynes, TM, Lenzen, M, Steinberger, JK and Bai, X (2011) Comparison of Household Consumption and Regional Production Approaches to Assessing Urban Energy Use and Implications for Policy. *Energy Policy,* 39 (11). 7298-7309.

Berrigan, D., Pickle, LW., Dill, J. (2010) Associations between street connectivity and active transportation. *International Journal of Health Geography.* 2010 Apr 23;9:20.

Calthorpe, Peter (2013). The real problem with China's Ghost Towns. *Metropolis POV*, September 1, 2013. Available online at http://www.metropolismag.com/Point-of-View/August-2013/The-Real-Problem-with-Chinas-Ghost-Towns/ [Accessed July 14, 2014]

Cao, X., Mokhtarian, P. L., & Handy, S. L. (2007). Do changes in neighbourhood characteristics lead to changes in travel behavior? A structural equations modeling approach. *Transportation,* 34(5), 535-556.

Cerin, E., Saelens, B., Sallis, J., Frank, L. (2006) Neighborhood Environment Walkability Scale: Validity and Development of a Short Form. *Medicine and Science in Sports and Exercise*, 2006:1682-1691.

Cervero, R., & Radisch, C. (1996). Travel choices in pedestrian versus automobile oriented neighborhoods. *Transport Policy,* 3(3), 127-141.

Cervero, R., & Murakami, J. (2010). Effects of built environments on vehicle miles traveled: evidence from 370 US urbanized areas. *Environment and Planning A,* 42(2), 400-418.

Chandon, P., & Wansink, B. (2010). Is food marketing making us fat? A multi-disciplinary review. *Foundations and Trends in Marketing,* 5(3), 113-196.

Chang, H., Parandvash, G. H., & Shandas, V. (2010). Spatial variations of single-family residential water consumption in Portland, Oregon. *Urban Geography,* 31(7), 953-972.

Cold, Birgit (1998). *Aesthetics, Well-being and Health: Abstracts on theoretical and empirical research within environmental aesthetics.* Norsk Form: Oslo.

Corbella, H. M., & Pujol, D. S. (2009). What lies behind domestic water use? A review essay on the drivers of domestic water consumption. *Boletín de la Asociación Geográfica de España,* 50, 297-314.

Dietz, T., Gardner, G. T., Gilligan, J., Stern, P. C., & Vandenbergh, M. P. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences,* 106(44), 18452-18456.

Dobbie, J. M. (1968). A survey of search theory. *Operations Research,* 16(3), 525-537.

Dodman, D. (2009). Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories. *Environment and Urbanization,* 21(1), 185-201.

Erickson, P., Chandler, C., & Lazarus, M. (2012). Reducing greenhouse gas emissions associated with consumption: A methodology for scenario analysis. *Stockholm Environment Institute,* Working Paper 2012, 5.

Ewing, R., & Cervero, R. (2001). Travel and the built environment: a synthesis. *Transportation Research Record: Journal of the Transportation Research Board,* 1780(1), 87-114.

Ewing, R., Bartholomew, K., Winkelman, S., Walters, J. and Chen, D. (2007). *Growing Cooler: The Evidence on Urban Development and Climate Change.* Washington, D.C.: Urban Land Institute.

Ewing, R., & Rong, F. (2008). The impact of urban form on US residential energy use. Housing Policy Debate, 19(1), 1-30.

Ewing, R., Nelson, A. C., Bartholomew, K., Emmi, P., & Appleyard, B. (2011). Response to Special Report 298 Driving and the built environment: the effects of compact development on motorized travel, energy use, and CO2 emissions. *Journal of Urbanism,* 4(1), 1-5.

Frank, L. D., & Pivo, G. (1994). Impacts of mixed use and density on utilization of three modes of travel: single-occupant vehicle, transit, and walking. *Transportation Research Record,* 44-44.

Frank, L. D., Saelens, B. E., Powell, K. E., & Chapman, J. E. (2007). Stepping towards causation: do built environments or neighbourhood and travel preferences explain physical activity, driving, and obesity? *Social Science & Medicine,* 65(9), 1898-1914.

Freeman, L. (2001). The effects of sprawl on neighbourhood social ties. Journal of the American Planning Association, 67(1), 69-77.

Gibbs, R. J. (2011). *Principles of Urban Retail Planning and Development.* John Wiley and Sons.

Gowdy, J. M. (2008). Behavioral economics and climate change policy. *Journal of Economic Behavior & Organization*, 68(3), 632-644.

Groth, P., Miller, R., Nadkarni, N., Riley, M., & Shoup, L. (2008). *Quantifying the Greenhouse Gas Benefits of Urban Parks.* San Francisco, California: The Trust for Public Land.

Handy, S. (1993). A Cycle of Dependence: Automobiles, accessibility, and the evolution of the transportation and retail hierarchies. *Berkeley Planning Journal,* 8(1993) 21-43.

House-Peters, L., Pratt, B., & Chang, H. (2010). Effects of Urban Spatial Structure, Sociodemographics, and Climate on Residential Water Consumption in Hillsboro, Oregon. *JAWRA Journal of the American Water Resources Association,* 46(3), 461-472.

Høyer, K. G., & Holden, E. (2003). Household consumption and ecological footprints in Norway–does urban form matter? *Journal of Consumer Policy,* 26(3), 327-349.

Jiao, J., Moudon, A., & Drewnowski, A. (2011). Grocery shopping: how individuals and built environments influence choice of travel mode. *Transportation Research Record: Journal of the Transportation Research Board,* (2230), 85-95.

Johnson, E. J., Shu, S. B., Dellaert, B. G., Fox, C., Goldstein, D. G., Häubl, G. and Weber, E. U. (2012). Beyond Nudges: Tools of a choice architecture. *Marketing Letters,* 23(2), 487-504.

Kahneman, D. (2002). Maps of bounded rationality: A perspective on intuitive judgment and choice. *Nobel Prize Lecture,* 8, 351-401.

Kim, S., Ulfarsson, G. F., & Todd Hennessy, J. (2007). Analysis of light rail rider travel behavior: impacts of individual, built environment, and crime characteristics on transit access. *Transportation Research Part A: Policy and Practice,* 41(6), 511-522.
Krizek, K. J. (2003). Residential relocation and changes in urban travel: does neighborhood-scale urban form matter? *Journal of the American Planning Association,* 69(3), 265-281.
Larsen, K., & Gilliland, J. (2009). A farmers' market in a food desert: Evaluating impacts on the price and availability of healthy food. *Health & Place,* 15(4), 1158-1162.
Law, P., & Taylor, B. D. (2001). Shelter from the storm: Optimizing distribution of bus stop shelters in Los Angeles. *Transportation Research Record: Journal of the Transportation Research Board,* 1753(1), 79-85.
Leslie, E., Saelens, B., Frank, L., Owen, N., Bauman, A., Coffee, N., Hugo, G. (2005) Residents' perceptions of walkability attributes in objectively different neighborhoods: a pilot study. *Health & Place* 11, 227-236.
Leyden, K. M. (2003). Social capital and the built environment: the importance of walkable neighborhoods. *American Journal of Public Health,* 93(9), 1546-1551.
Lynch, K. (1984). *Good City Form.* Cambridge, MA: MIT Press.
McCormack, G. R., Rock, M., Toohey, A. M., & Hignell, D. (2010). Characteristics of urban parks associated with park use and physical activity: a review of qualitative research. *Health & Place,* 16(4), 712-726.
Mehaffy, M., Porta, S., Rofe Y. and Salingaros, N. (2010). Urban nuclei and the geometry of streets: The 'emergent neighborhoods' model. *Urban Design International,* 15(1), 22-46.
Mehaffy, M (2013). Prospects for scenario-modelling urban design methodologies to achieve significant greenhouse gas emissions reductions. *Urban Design International,* 18(4), 313-324.
Montanya, E.C., & Keith, D. W. (2011). LEED, Energy Savings, and Carbon Abatement: Related but Not Synonymous. *Environmental Science & Technology,* 45(5), 1757-1758.
Nasar, J.L. (1997). Neo-traditional development, auto dependency and sense of community. in *Proceedings of the 28th Annual Conference of the Environmental Design Research Association.* Edmond, OK: Environmental Design Research Association.
National Academy of Sciences (2009). Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions. Available online at: http://www.nap.edu/catalog/12747.html
Nelson, A. C., & Allen, D. (1997). If you build them, commuters will use them: association between bicycle facilities and bicycle commuting. *Transportation Research Record: Journal of the Transportation Research Board,* 1578(1), 79-83.
Newsham, G. R., Mancini, S., & Birt, B. J. (2009). Do LEED-certified buildings save energy? Yes, but…. *Energy and Buildings,* 41(8), 897-905.
Olivier, J.G.J., Janssens-Maenhaut, G., Muntean, M., Peters, J. A.H.W. (2013). *Trends in global CO2 emissions: 2013 Report.* The Hague: PBL Netherlands Environmental Assessment Agency. Available online at http://edgar.jrc.ec.europa.eu/news_docs/pbl-2013-trends-in-global-co2-emissions-2013-report-1148.pdf [Accessed July 14, 2014]
Pacala, S. and Socolow, R. (2004) Stabilization wedges: Solving the climate problem for the next 50 years with current technologies. *Science,* 305:968–972.
Polimeni, J. M. (2008). Empirical evidence for the Jevons Paradox. In *The Jevons Paradox and the Myth of Resource Efficiency Improvements*, 141-172. New York: CRC Press.
Poudenx, P. (2008). The effect of transportation policies on energy consumption and greenhouse gas emission from urban passenger transportation. *Transportation Research Part A: Policy and Practice,* 42(6), 901-909.
Pucher, J., & Dijkstra, L. (2003). Promoting safe walking and cycling to improve public health: lessons from the Netherlands and Germany. *American Journal of Public Health,* 93(9), 1509-1516.
Saelens B., Sallis J., Frank L. (2003). Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. *Annals of Behavioral Medicine.* 2003, 25(2):80-91.
Schmenner, R. W. (1976). The demand for urban bus transit: A route-by-route analysis. *Journal of Transport Economics and Policy,* 68-86.
Selinger, E. and Whyte, K. P. (2010). Competence and trust in choice architecture. *Knowledge, Technology & Policy,* 23(3-4), 461-482.
Sent, E. M. (2004). Behavioral Economics: How psychology made its (limited) way back into economics. *History of Political Economy,* 36(4), 735-760.
Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological Review*, 63(2), 129
Smith, Gerald E.; Venkatraman, Meera P.; Dholakia, Ruby Roy (1999). Diagnosing the search cost effect: Waiting time and the moderating impact of prior category knowledge. *Journal of Economic Psychology* 20: 285–314.
Smith, T. G. (2004). The McDonald's Equilibrium. Advertising, empty calories, and the endogenous determination of dietary preferences. *Social Choice and Welfare,* 23(3), 383-413.
Sorrell, S. (2009). Jevons' Paradox revisited: The evidence for backfire from improved energy efficiency. *Energy Policy,* 37(4), 1456-1469.
Thaler, R., Sunstein, C., & Balz, J. (2010). Choice architecture. *Social Science Research Network.* Available at SSRN 1583509.
Wahlgren, L. and Schantz, P. (2012). Exploring bikeability in a metropolitan setting: Stimulating and hindering factors in commuting route environments. *BMC Public Health* 2012, 12:168
Walker, R. E., Keane, C. R., & Burke, J. G. (2010). Disparities and access to healthy food in the United States: a review of food deserts literature. *Health & Place,* 16(5), 876-884.
Wilkinson, N. (2008). *An Introduction to Behavioral Economics.* New York: Palgrave Macmillan.
Winters, M., Brauer, M., Setton, E. M., & Teschke, K. (2013). Mapping bikeability: a spatial tool to support sustainable travel. *Environment and Planning B: Planning and Design,* 40(5), 865-883.
World Bank (2011). Representative GHG Baselines for Cities and Their Respective Countries. Website table with citations. Available at http://siteresources.worldbank.org/INTUWM/Resources/GHG_Index_Mar_9_2011.pdf [Accessed July 14, 2014]
Wrigley, N., Warm, D., Margetts, B., & Whelan, A. (2002). Assessing the impact of improved retail access on diet in a 'food desert': a preliminary report. *Urban Studies,* 39(11), 2061-2082.

Younger, M., Morrow-Almeida, H. R., Vindigni, S. M., & Dannenberg, A. L. (2008). The built environment, climate change, and health: Opportunities for co-benefits. *American Journal of Preventive Medicine,* 35(5), 517-526.
Zhao, F., Chow, L. F., Li, M. T., Ubaka, I., & Gan, A. (2003). Forecasting transit walk accessibility: regression model alternative to buffer method. *Transportation Research Record: Journal of the Transportation Research Board,* 1835(1), 34-41.