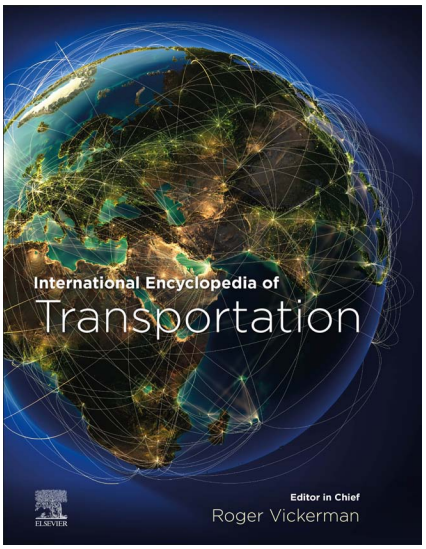

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Community Severance

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What is Community Severance?

Community severance occurs when transport infrastructure or vehicles using that infrastructure are a physical or psychological barrier to the movement of pedestrians and other modes of local transport, separating people from places and from other people. This may lead to changes in travel behavior and to wider negative effects on individuals, including restricted access to goods, services, resources, and opportunities; higher probability of social exclusion; fewer social contacts; and impaired health and well-being (Anciaes et al., 2015; Héran, 2011; James et al., 2005; Mindell and Karlsen, 2012; Mindell et al., 2017). It can also lead to effects at the level of the community, including reduced vitality of local businesses, reduced social cohesion, and deterioration in the local environment (Appleyard and Lintell, 1972; Appleyard et al., 1981; Appleyard, 2020; Jacobs, 1961).

The concept of community severance is sometimes described as the "barrier effect" of transport. Although the two concepts are often used interchangeably, barrier effect tends to refer mainly to the loss of mobility and accessibility of pedestrians, while community severance also includes the wider negative effects on individuals and communities (Anciaes, 2015).

Causes and Extent of the Problem

The most extreme cases of community severance are those posed by linear transport infrastructures (such as motorways, dual-carriageway roads, and railways) where longitudinal movement by pedestrians is not allowed and transversal movement is limited to a few locations where grade-separated pedestrian crossing facilities are provided (e.g., footbridges or underpasses). In this type of infrastructure, severance is enforced by embankments, cuttings, or physical barriers (e.g., walls, fences, guard railings) that prevent pedestrians from crossing (**Fig. 1**). Rivers and canals can also cause severance, although this is usually attenuated by the amenity value they provide.

Severance can also be caused by the vehicles using the infrastructure, even in cases where crossing is physically possible. This is the case of roads with large amounts of motorized traffic, or traffic moving at fast speed (**Fig. 2**). Pedestrians find it difficult to cross these roads outside designated crossing facilities due to the lack of safe gaps in the traffic. This is aggravated in roads with many lanes; complex road layouts (e.g., roundabouts, large junctions, turning lanes); many large vehicles in the traffic (e.g., buses, heavy goods vehicles); vehicles parked on the curbside; and lack of dropped curbs or a median strip where pedestrians can stop while crossing. Public transport vehicles running on dedicated lanes (including tram and light rail lines, and bus rapid transit systems) may also cause severance.

Crossing facilities often aggravate, rather than reduce, severance. Underpasses are prone to flooding and tend to be perceived as unpleasant and unsafe, especially when they have insufficient lighting or are poorly designed and maintained (**Fig. 3**). To a smaller degree, these issues also apply to footbridges, which can also be problematic for people with fear of heights (**Fig. 4**). Using underpasses or footbridges also implies extra effort and detours to use stairs or ramps. In some cases, ramps (or lifts) are not

Figure 1 Severance caused by transport infrastructure (Dubai, United Arab Emirates).

Figure 2 Severance caused by motorized traffic (Shanghai, China).

Figure 3 Severance aggravated by crossing facilities (underpasses) (Chişinău, Moldova).

Figure 4 Severance aggravated by crossing facilities (footbridges) (Valparaíso, Chile).

provided, limiting the use of the facilities by older people and those with mobility impairments. At-grade crossing facilities, such as signalized crossings, also have problems, when waiting time is long or the time allowed for crossing is too short.

Large nonlinear transport infrastructure, such as car parks, railway stations and depots, ports, and airports, may also pose barriers to pedestrians. However, movement across railway stations is sometimes possible—stations can even be one of the few safe crossing points to cross the railway line.

In some cases, severance caused by transport infrastructure is compounded by the presence of other land uses with poor permeability for pedestrians, such as industrial areas, hospitals, and university campuses. This may lead to the isolation of some residential areas, which become enclosed by barriers to pedestrian movement on all sides.

Severance can originate from a variety of processes. For example, a new transport infrastructure may be aligned to cross an existing community. This is often due to geographic and technical constraints, but it can also be due to economic factors (e.g., lower value of the land crossed) or political factors (e.g., lack of political power of local communities, or political bias of decision makers) (Appleyard, 2020). A different process leading to severance is a progressive change to an existing infrastructure, such as the increase of road traffic volumes resulting from urban and economic growth. This is often accommodated by planners with changes to the road design, such as widening the carriageway and reducing the number of pedestrian crossing facilities.

Severance can also originate from the emergence of new residential areas around transport infrastructure crossing previously nonresidential land. This often happens due to urban growth, as previously "undesirable" areas crossed by transport infrastructure become one of the few possibilities for new land developments. The desirability of those areas, translated into land values, may increase because the presence of transport infrastructure increases accessibility by motorized modes. Again, political factors are relevant, as the conversion from nonresidential to residential land depends on land use regulations.

The problem of severance is spread around the world, especially in urban and suburban areas (see, e.g., Future of London, 2018). While some solutions are being implemented in some cities, reviewed later in this chapter, severance is intensifying in others. In large and fast-growing Asian cities, the increase in travel demand has often translated into massive multilevel roads, where the barrier effect is compounded by visual intrusion (Badami, 2009). In many developing countries, growing investment in roads has also failed to address the needs of pedestrians, even where walking is still the main mode of transport (Bradbury, 2014).

Direct Effects

The main direct effects of community severance are the loss of mobility (ability to move) and accessibility (ability to reach places) of pedestrians. In the presence of a barrier, pedestrians must either make a detour to reach crossing facilities (which implies extra effort and delays to walking trips) or cross in a place without facilities (with the associated risk of collision with vehicles). In both cases, the barrier can also be perceived by pedestrians as unpleasant due to exposure to noise, vibration, dust, and air pollution; feelings of intimidation caused by vehicles; and personal security issues of using an environment dominated by motorized vehicles and with few other pedestrians (Hine 1996; James et al., 2005; Mindell et al., 2017). Although most of the existing evidence deals with pedestrians, some of these effects also apply to cyclists. Detours and delays also affect the provision of services such as bus routes, post distribution, freight, waste collection, policing, and emergency services, as well as local trips by private car.

Regardless of the effect on movement across the barrier, there is also a psychological effect of being separated from the other side. This can be explained by the visual intrusion of the infrastructure and auxiliary structures (e.g., walls, fences, noise barriers, crossing facilities) or the noise and air pollution from traffic (Héran, 2011). This psychological effect may change the residents' perceptions about their local area. Qualitative studies have shown, for example, that when barriers exist, residents will have a narrower "personal

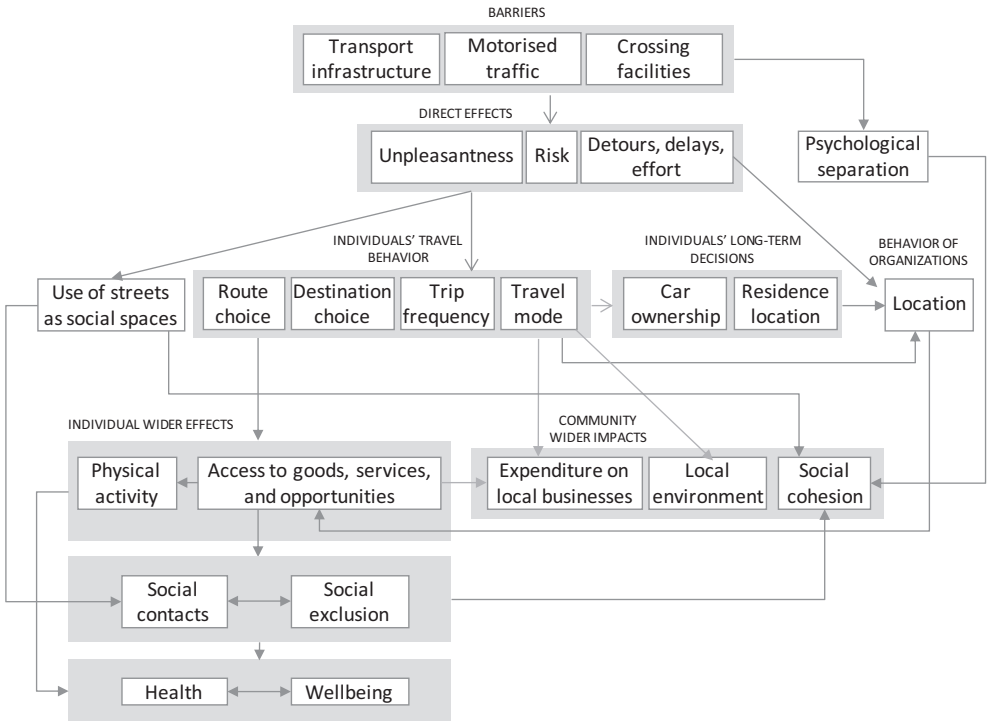

Figure 5 Chain of potential wider effects of community severance.

neighborhood," limited to their side of the barrier (Lassière, 1976). In addition, they will tend to have negative perceptions of the area next to the barrier on their side, and of the whole area on the other side.

However, the existence and extent of the direct effects of severance depend on how the barrier interacts with the local built environment. The separation of a residential area from another residential area or from a commercial or leisure area is more impactful than the separation from an industrial estate or undeveloped land. It is also likely that severance increases with proximity from the barrier, although not linearly, because people living next to the barrier may not dissociate the barrier effect from other effects, such as noise and air pollution. Feelings of severance may also extend far from the barrier, if the barrier disrupts the individuals' movement patterns. This is for example the case when difficult access to bus stops or a train station located on the other side of the barrier affects the frequency and destinations of non-local trips.

Feelings of severance also depend on perceptions about the barrier. The same traffic volumes and speeds are perceived differently by different people at different times of the day (Anciaes et al., 2017). Individuals who use the infrastructure for movement by car or public transport, or as destination for shopping, may not perceive the infrastructure as a barrier. Even underpasses and footbridges can become attractive when they have an innovative design or become shopping areas. Perceptions of severance may also decrease with the amount of time the individual has lived near the barrier. A new barrier disrupts existing mobility patterns and perceptions about neighborhoods but, with time, individuals may adapt to the barrier (Lassière, 1976). Finally, barriers can even be regarded positively if individuals wish to be separated from the communities on the other side.

Wider Effects

The direct effects of severance may lead to a complex chain of wider negative effects, mediated by changes in the behavior of individuals and organizations. These effects may be felt at the level of individuals or the whole community (i.e., residents, workers, and other people using the area). **Fig. 5** synthesizes the chain of effects, which are described in detail the subsections below. It should be noted that although all the links in the figure are plausible, they are supported by varying levels of empirical evidence.

Behavior of Individuals and Organizations

The loss of mobility and accessibility due to the barrier is a constraint to the travel behavior of local residents. Individuals may change their routes to avoid the barrier, or change their destinations, going to places on their side of the barrier, rather than those on the other side (Anciaes et al., 2019; Hine 1996; Mindell et al., 2017). They may also reduce the number of trips or change travel mode, replacing walking and cycling with trips by motorized modes (car or bus), even when the destinations across the road are within

walking distance (Powers et al., 2019). The use of streets as social spaces is also likely to decrease (Appleyard and Lintell, 1972; Appleyard et al., 1981). In the longer term, severance may influence decisions such as whether to own a car and where to live.

Businesses and public organizations may also adapt to the presence of the barrier and to the changes in the individuals' travel behavior. Possible effects include more businesses catering to car users (in larger premises with car parks); and facilities being provided on both sides of the barrier, to cater to what have become separate markets. The routes of services such as post and waste removal may also change to reduce detours and delays. In the long term, the separation of communities may contribute to changes in school catchment areas and administrative areas.

Wider Effects on Individuals

The constraints that severance imposes on travel behavior reduce the individuals' ability to access goods and services, when the facilities providing them (e.g., shops and public facilities) are located on the other side of the barrier (James et al., 2005; Mindell et al., 2017). It also affects the ability to access opportunities such as employment, education, leisure, and other people. This may increase the probability of social exclusion and reduce the individuals' network of social contacts (Mackett and Thoreau, 2015).

Health and well-being can be affected through a variety of pathways. This can be a direct effect of the reduction in physical activity (via the suppression of walking trips), social exclusion, and reduction of social contacts; three pathways with solid evidence from public health research (see Mindell and Karlsen, 2012). Reduced accessibility also affects decisions to visit health-supportive destinations such as health centers, public parks, and shops offering healthy food. The stress and anxiety linked to collision risk, psychological effects of separation, and restrictions to access places and people may also affect mental health and subjective well-being.

Wider Effects on Communities

Local businesses are affected by the constraints posed by severance on the number of trips that local residents make and the travel mode they use. Evidence shows that although car users tend to spend more than pedestrians do on a single visit to shopping areas, they also make fewer trips, resulting in an overall negative effect on expenditure in local businesses (Jones et al., 2007). There is also a tendency for areas next to large transport barriers to have little economic activity due to low pedestrian flows (Jacobs, 1961). Severance is also linked to other negative economic outcomes, including income loss (due to constraints in accessing employment and education); depreciation of residential and commercial property prices; costs of extra trips by motorized modes; cost of detours to the routes of services; and congestion due to the increase in local traffic. In rural areas, there is also a loss of efficiency due to the separation of fields.

Social cohesion is also affected by the lower level of use of streets as social spaces; perceptions of separation and reduced social contacts within the community; and social exclusion of some individuals (Appleyard and Lintell, 1972; Appleyard et al., 1981). As noted, severance also influences perceptions of personal security and may even contribute to an increase in crime and vandalism, due to the reduction in the number of people using the streets and people's reduced sense of ownership and responsibility for their neighborhood.

Due to the replacement of walking trips with trips using motorized modes, severance also has environmental effects, both local (e.g., noise, air pollution) and global (e.g., use of nonrenewable resources, emissions of greenhouse gases). Outside urban areas, severance brought about by transport infrastructures and motorized traffic affects the movement of wildlife.

Equity Issues

Severance raises equity issues, linked to its effects on vulnerable groups. Due to collision risk and exposure to pollution on busy roads, adults will be unwilling to let children walk, cycle, or play outdoors unsupervised, affecting the children's independence and mental and physical development (Shaw et al., 2015). Due to their slower walking speeds, older people and those with mobility impairments are also vulnerable when crossing busy roads and may respond by suppressing walking trips (Musselwhite and Haddad, 2010). This restricts independent mobility and social contacts, two of the main components of healthy living for those groups. Older people, as well as women, also tend to be more concerned with personal security when using footbridges, underpasses, and roads dominated by vehicles and with few other pedestrians (James et al., 2005).

Some groups are also constrained in their actions to reduce severance due to the lack of alternative modes of transport, travel destinations, or walking routes. For example, low-income groups face more economic constraints to own and use a private car and may not be able to afford public transport. In most countries, women also tend to have lower levels of access to private vehicles and more demands on their time. In some cases, older people and some ethnic and religious groups are also dependent on local facilities and social contacts. Older people and those with impairments also find it more difficult to make detours to walking trips (Mindell et al., 2017).

Equity issues may also arise due to patterns in residence location of some groups. There is evidence that low-income groups tend to be disproportionately exposed to negative effects of transport such as noise and air pollution. This may be explained by the sorting of income groups to different levels of environmental quality, through housing markets: properties in cleaner and quieter areas have higher prices and rents, and may be unaffordable to low income groups. There is also some evidence of ethnic minorities being

disproportionately affected by noise and air pollution, which may be due to an income effect, segregation, or lack of political power of those groups. It is possible that these patterns also apply to severance, although empirical evidence has only recently started to emerge (Lara and Silva, 2019; Appleyard, 2020).

Policies

The most radical policy intervention to address severance is to remove the infrastructure causing the problem (Bocarejo et al., 2012). The most well-known example is the Cheonggye Expressway in Seoul, a multilevel motorway removed in 2005 to restore a stream and create a linear park. There is solid evidence of the success of this type of intervention, as shown by indicators such as increases in walking trips and in the use of public places, and increases in the value of properties in nearby areas (Kang and Cervero, 2009). However, when the removal of the infrastructure is accompanied by building a bypass in other areas, the problem is simply displaced. Even when bypasses are built in nonresidential areas, market processes may lead to the area becoming residential in the future, recreating severance. Rerouting the infrastructure to be aligned with a river or other natural feature also restricts access and reduces the amenity value of that feature.

Another option is to shift the infrastructure up or down. For example, the Central Artery in Boston was partly buried in a tunnel in 2003 and replaced with parks and a boulevard. This solution is expensive and not always technically feasible. A less expensive solution is sinking, without burying, the infrastructure, which allows for the replacement of grade-separated crossing facilities with at-grade facilities, although this still limits the number of available crossing points. Moving the infrastructure up, using flyovers, removes the barrier to pedestrian movement, but it does not remove, and can in fact increase, the psychological effect of separation, due to visual intrusion.

The barrier to pedestrian movement can also be reduced by adding new crossing facilities, which increase the number of available points where pedestrians can cross, reducing detours and increasing safety. Other options include modifying the type of existing facilities (e.g., replacing footbridges and underpasses with at-grade facilities), changing their location (to align with pedestrian desire lines), or changing their characteristics (e.g., improving the design and maintenance of footbridges and underpasses; and reducing crossing stages and allowing more time to cross in signalized crossings).

Another possibility is to make crossing easier at the points where no formal crossing facilities are provided. In the case of roads, this can be achieved by removing physical barriers; reducing the number of lanes assigned to motorized modes or the width per lane (reallocating the released space to pedestrians); or simply by adding dropped curbs and pedestrian refuges in the middle of the road. Adding a median strip extending along the road also allows pedestrians to walk along it and cross when a suitable gap in the traffic appears. "Courtesy crossings" have also become more common, using design features such as stripes, colored or textured surfaces, visual narrowing of the carriageway, and ramps, to encourage drivers to stop for pedestrians.

Severance can also be reduced by policies to change traffic, rather than the infrastructure. Road traffic volumes can be reduced by regulatory policies to restrict traffic (e.g., closure of roads to motorized traffic, road space rationing, one-way traffic schemes, high-occupancy lanes, removal of parking spaces) or by economic policies such as road pricing. Traffic speeds can be reduced by imposing lower speed limits, enforcing existing limits, or adding traffic calming design features. The problem of these interventions is that traffic volume and speed usually have an inverse relationship, so reducing one may increase the other.

Minor changes in the road environment can also reduce perceptions of severance in busy roads. Examples include improving pavements; removing obstructions; adding dropped curbs; and adding or improving lighting, greenery, street furniture, surveillance, and provision for the mobility-impaired. Even in the cases where crossing is not possible, improving the environment at the places where the local street network meets the road may also improve negative perceptions about the barrier.

Despite their potential benefits, it is not easy to make a political or business case for interventions to remove or reduce severance. This is partly because there are few established methods to objectively identify severance, measure its intensity, and assess the effect of interventions to reduce it (Anciaes et al., 2015). National-level official manuals for the assessment of transport projects often omit severance or mention it in a checklist of social or environmental impacts, without providing practical guidance. In some cases, simple qualitative scales are proposed, with a few loosely defined points. At the city level, only a few governments use quantitative indicators. For example, Transport for London uses a weighted average of number of lanes, traffic counts, and speeds. Methods for the monetization of severance are even rarer and when they exist, they capture only specific aspects of the problem (Anciaes et al., 2015). For example, the official guidance in Germany, Italy, and Australia currently suggests monetizing detours to walking trips by applying unit values of time. The tendency has been for less, rather than more, objectivity in the assessment of severance and in several countries (Sweden, Denmark, Switzerland) detailed methods to quantify and value severance have been dropped from official manuals over the years.

Research

There is a long, if discontinuous, history of research on community severance; the earliest studies dating from the 1950s. Appleyard and Lintell (1972) conducted the first high-impact study, producing a simple but powerful result that people living in roads with higher levels of motorized traffic in San Francisco had fewer friends and acquaintances and made fewer trips across the road, compared to those living in quieter roads. During the late 1970s and early 1980s, there were parallel efforts in several countries, with

governments commissioning comprehensive reports on severance. A study for the Department of Environment in the United Kingdom (Lassière 1976) documented the impact of busy roads on the travel behavior and neighborhood perceptions of local residents. In France, Loir and Icher (1983) looked at the interaction between different types of road infrastructure, urban dynamics, and people's perceptions in creating severance. In Sweden, Korner (1979) systematized the various effects of road barriers into different levels and in Norway, Lervåg (1984) reviewed methods to assess severance.

In the following 25 years, the only studies dealing specifically with severance were a few methodological reports for transport authorities in England (Clark et al., 1991) and New Zealand (Read and Cramphorn, 2001; Tate 1997). Research resumed only in the 2010s, with a new emphasis on interdisciplinarity. In the United Kingdom, the Street Mobility project at UCL (University College London) developed a suite of tools to identify and measure severance caused by busy roads (Mindell et al., 2017). In France, Frédéric Héran published the first book-length study on severance (Héran, 2011), proposing a broad approach to study the problem, integrating it with other transport and urban issues. Evidence on the direct and wider effects of severance has also been growing, with studies replicating Appleyard and Lintell's results in several countries (Hart and Parkhurst, 2011; Wiki et al., 2018). Evidence has also emerged on the impacts of severance on subjective well-being (Anciaes et al., 2019; Foley et al., 2017).

Several assessment methods have been proposed but have seldom been included in routine transport practice. Some of the methods rely on simple indicators of the size of the barrier, obtained by quantifying characteristics of road design (e.g., road width, number of lanes) and traffic (e.g., traffic volumes, proportion of large vehicles, traffic speed). More complex indicators measure the effects of the barrier, such as delays and detours. These indicators are sometimes fed into broader indicators of accessibility to local facilities or catchment areas for walking trips (Van Eldijk, 2019). Unit values are usually multiplied by the size of the affected population, defined as the population living within a certain radius from the barrier. A few authors have proposed indicators based on pedestrians' perceptions of safety (Tate, 1997) and observed road crossing behavior (Russell and Hine, 1996). Surveys and qualitative methods (e.g., participatory mapping) have also been used to capture the perceptions and priorities of local residents (Mindell et al., 2017).

There have been recent developments in methods to monetize the benefits of reducing severance. These methods apply standard approaches for the valuation of nonmarket goods, based on willingness to pay. Stated preference approaches (e.g., Anciaes and Jones, 2020) use surveys capturing people's choices among different scenarios, which allows for the calculation of unit values for the characteristics of road design, traffic, and crossing facilities. Revealed preference approaches (e.g., Kang and Cervero, 2009) estimate the value of severance as reflected in market prices, usually property prices. However, in most cases, revealed preference approaches have treated severance as a yes/no issue (the presence/absence of the road) or in terms of a single characteristic (usually traffic volumes). A problem common to both stated and revealed preference approaches is that they cannot capture the overall cost of severance, especially the costs of the wider effects on individuals and communities.

Despite these developments, research on severance still lags that of other negative effects of transport, such as noise and air pollution, and is still faced with unanswered questions and the lack of robust assessment methods. Research has focused almost exclusively on the effects of road traffic on pedestrians in roads without physical barriers. Little is known about more absolute types of barriers, such as those posed by motorways and by railways, where severance derives mainly from the infrastructure itself, and not from traffic. Research has also not moved beyond the study of "barrier" to that of "enclosure," in areas that are surrounded by barriers on all sides. There is also little knowledge on the effects of severance on cyclists and local motorized traffic. Another important gap, which is becoming a pressing policy issue, is how to address severance in fast-growing in cities in developing countries.

Conclusions

Community severance, or the barrier effect of transport infrastructure and traffic, reduces the mobility and accessibility of pedestrians and users of other modes of local transport, and can lead to changes to travel behavior and to wider negative effects on individuals and communities. The problem is more impactful for children, older people, women, and low-income groups. There are several possible solutions to remove or reduce community severance but few methods for assessing those solutions. Research on severance still lags that of other negative effects of transport, such as noise and air pollution, and available evidence does not yet cover all possible transport barriers and their effects.

See Also

Accessibility; Transportation Equity; Mobility; Pedestrian Crossing (Pelican, zebra, etc.); Pedestrians; Access to Transport; Wellbeing and Travel Satisfaction; Travel Behavior

Relevant Websites

https://www.ucl.ac.uk/street-mobility/toolkit
UCL Street Mobility Toolkit to assess community severance

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